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Welding the 26-in. Steel Pipe Line for the Butte Water Supply

Welded Steel and Wood-Stave Pipe Line for Butte Water Company

By Eugene Carroll

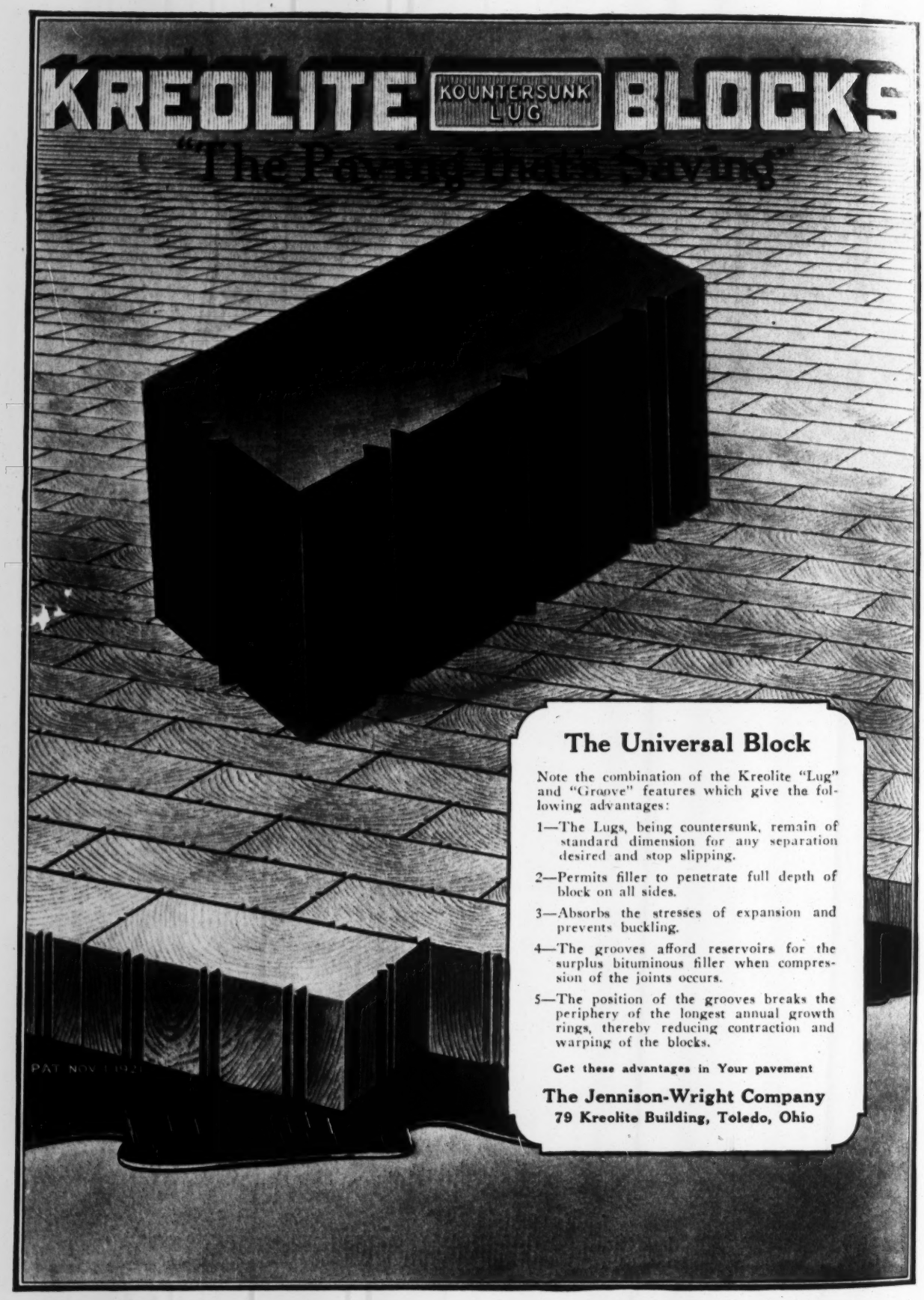
Synura and Other Organisms in the Catskill Water Supply

By W. W. Brush

Some Neglected Points in Structural Design

By Robins Fleming

What Some Industrial Leaders Think of Engineering Education



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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A Job for Every Citizen

LAST week we commented in these pages on the results of the Arms Conference. The evolving of the treaties, though, is only a preliminary step. The final one, the essential one, for the United States is to have them confirmed by the Senate. If the Senate rejects the treaties we shall lose for a generation, at the very least, the confidence and respect of the world. We shall have no influence in world affairs. Might will again take the ascendency in international relations. This cannot be allowed to happen. It is a solemn duty of every citizen who believes that the results at Washington are good to bring his influence to bear upon his senators. We called the conference. If the results are good—and the *News-Record* believes that they are—we must back it by acceptance of its conclusions.

Chlorination and Synura

EVIDENCE that chlorination may be an aid in controlling tastes and odors in public water supplies is afforded by the recent experience of New York city, reviewed by Mr. Brush elsewhere in this issue. It was found that while the normal amount of chlorine for reduction of bacteria increased the bad taste caused by Synura—much as chlorine at Milwaukee and elsewhere brought out tastes due to pollution by coal-tar wastes—an *excess* of chlorine reduced taste. Further observations on this and other taste and odor-producing organisms, both in New York city's reservoirs and in other water supplies, may be needed to show how generally reliance may be placed on excess chlorine in those sudden outbursts of tastes and odors which now and then challenge the water engineer and biologist. Meanwhile the studies by Mr. Brush and Dr. Hale deserve careful attention.

Rolled Base for Brick Roads

ECONOMIES in brick-road construction are indicated by the conclusions reached by the U. S. Bureau of Public Roads as a result of an investigation of "rolled-base" types in Ohio. This form involves the use of a base consisting of gravel, crushed stone or slag, with a cushion, 1 to 2 in. thick, of sand or screenings. The two principal advantages of the rolled base are its lower cost, as compared with a concrete foundation, and the opportunities it offers for the use of local materials. The latter consideration, particularly in view of the existing high freight rates, is in line with the policies advocated at all recent meetings of roadbuilding organizations. Most of the rolled-base construction examined in Ohio, as described on p. 273 of this issue, had a thickness of 6 in., but where traffic conditions warrant, compacted bases 8 to 10 in. thick are recommended as suitable for all routes except trunk-line highways subjected to very heavy traffic. There has been evidenced on the part of both engineers and contractors a desire to bring down highway-construction costs. The more extended use of the rolled-base type, if properly placed, compacted and located where soil and drainage conditions are favorable, offers a means of accomplishing this result in the case of the type of surfacing under consideration. Such a pavement, of course, does not possess the rigidity of the concrete-base types, and consequently an asphaltic joint filler is to be preferred to cement grout.

Wood and Steel Conduits

PROGRESS in the design and economics of water-supply pipe lines is shown by the practice of the Butte Water Co. Satisfactory experience with wood-stave pipe up to a head of 250 ft., for portions of a pipe line completed in 1900, led the engineer-manager of the company, as related by him in this issue, to use wood for heads up to 300 ft. in duplicating the line. By this means, the amount of wood-stave pipe in some 27 miles of conduit was increased from 74 per cent in the first to 81½ per cent in the second line, besides permitting a change in location that saved nearly a mile in the length of the new conduit. Another feature of the second conduit was the use of lap-welded steel pipe for heads from 300 to 841 ft., with welded circumferential joints. These are some, but by no means all, of the points of interest in Mr. Carroll's notable article.

Fitting the Highway Organization To Its Task

MANY of the younger highway departments of southern and western states have this winter the responsible task of organizing for their first season of intensive construction. Generous bond issues have given them millions of dollars where previously they have had hundreds of thousands, and the people who have provided the money are demanding that it shall be speedily converted into improved roads. The situation presents the danger that the work of organizing for this expenditure will take the obvious direction of increased forces instead of that of increased capacity which comes from logical division of labor, centralized planning to co-ordinate effort, educational supervision, a skilled personnel trained in teamwork and, above all, a high organization morale.

Efficient organization is necessary if quantity production of high-class improved roads is to be economically secured. The older road-building states of the east and the north have learned this by long experience. Their highway departments are successful in the direct proportion that they have become smooth-working organizations for conducting a continuing business. Number of employees, or high individual skill, will not give success unless the other qualifications of good business organization exist. These are elementary principles, but they require to be emphasized because the indications are already clear that they will not prevail in a numbe

of states which are organizing to carry out extensive highway-construction programs this year, unless the state executives and their highway commissions review their present plans and make radical alterations.

Correction requires first the definite decision not to undertake construction more rapidly than the department forces are trained to plan and supervise it. With the people clamoring for roads this calls for determination and diplomacy. Criticism will most certainly develop and its danger must be checkmated. Here the national engineering societies and the associated general contractors through their local sections and state chapters can be of help. The construction industry has more to gain by establishing highway improvement as a continuing business than by any immediate increase in mileage.

Publicity Run Wild

ON MONDAY, following the Saturday night collapse of the Knickerbocker Theater in Washington, no one in Chicago could have had accurate information regarding the design of the building, the character of the designers and builders, or the cause of the failure. And yet on that day the Public Information Service of the American Association of Engineers issued to the press a bulletin headed "Comment: Knickerbocker Theater Collapse. Licensing Engineers and Architects Protects Public From Building Disasters," and containing the following sentences:

"The failure of the roof of this theater was due to a heavy snow load, but since no other large roofs in Washington failed from this cause the disaster was evidently due to either faulty design or construction, which would not have existed had licensed engineers or architects supervised the work. . . . The movement for the enactment of adequate licensing laws for the protection of the public from the activities of dabblers and quacks who formerly had only to hang out a shingle in order to qualify for business, has been actively supported by the American Association of Engineers, an organization of 24,000 professional engineers. It is to the credit of professional engineers that they are seeking to purge the profession of incompetence and protect the public from engineers-for-a-day."

This is the publicity instinct run wild. To support their licensing propaganda those responsible for the bulletin did not hesitate, while uninformed regarding facts, to place their interpretation on the accident. Surely such action does not add to the reputation of engineers for balanced judgment. We realize that the A. A. E., as such, cannot be held responsible for this expression, unless it be for failure to check those whose judgment is shown to warrant distrust. Unfortunately, though, the newspapers and the public will take the press bulletin as representative of the matured judgment of the association.

Faith in Licensing

THERE is comment elsewhere in these columns on the precipitate haste with which the American Association of Engineers—or, rather, some one apparently empowered to use the association's name—rushed into print regarding the Knickerbocker Theater collapse. There is an additional point in the publicity bulletin to which we wish to call attention, namely, the simple faith with which its author regards registration of engineers as a full and sufficient preventive of future structural failures. "The disaster," says the bulletin, "was evidently due to either faulty design or construction, which would not have existed had licensed engineers or architects supervised the work."

We wish that we could share this faith in the efficacy of licensing—this cure-all character of public registration. But we can't. We are too strongly impressed with the existence of incompetent medical men and lawyers, even after years of registration. Moreover, the conditions which insure or even promote competency are worse in engineering than they are in law and medicine.

In those more matured professions the practical legal validity and the effectiveness of the laws are secured by the determination of the professions to keep the ranks as pure as possible. The country medical associations and the bar associations are the real agencies of professional improvement; the laws are but valuable adjuncts in making professional discipline more effective.

In engineering, alas, we have no such thing as professional discipline. Without it licensing laws will be idle. The demand today among engineers must be for strong enforcement of ethical codes. Then will licensing laws begin to be effective.

Even at that time inspection and approval of plans will have to remain as a third safeguard of public safety.

Publicity for Trade Association Activities

A CONSTRUCTIVE service of much importance to industry has been performed by Mr. Hoover in securing from the Attorney-General a statement as to the legality of activities of trade associations. Interest centers naturally in the legitimacy of the collection and distribution of trade statistics. The indication is that such activity is not illegitimate under the conditions set by Mr. Hoover, namely, that the information be given simultaneously to consumers as well as producers.

The form in which Mr. Hoover has put his question will not be pleasing to many producers. They apparently fear to give the buyer full information regarding the functioning of the industry. The Secretary, though, holds that "information secured solely for the benefit of members and of a character that puts the membership, by reason of the information, in a position of advantage as compared with the public cannot be sanctioned by sound public policy." This is a view in which this journal heartily concurs, and which, as the readers know, it has repeatedly urged in these columns.

Of course, Mr. Hoover and Mr. Daugherty do not make the law of the land. What Mr. Daugherty has designated as not illegal as to statistical activities is obviously a course on the side of safety. The courts may hold that, provided there are no agreements on future action, distribution of statistics to members only is legal. Nevertheless, the drift of public thinking is in the direction of preventing trade associations taking advantage of the public. We believe that all of them will be in a stronger position with the public if they accept the new conditions and take the public into their confidence after the manner proposed by Mr. Hoover or by other means—obviously, directly through the press—of supplying statistics simultaneously to their members and to the buyers.

Special Theater Hazards and Safety

THE public concern about theater safety awakened by the Knickerbocker collapse may serve to produce valuable results. It is somewhat different from the typical sentiment of indignation that follows every sensational accident. Citizens and communities are in this case seeking not for a scapegoat but for unsafe conditions that may exist and their remedies. In the presence of this spirit of progress it is important that certain special factors of theater safety be recognized.

An abnormally large life hazard is involved in theater occupancy. With large audiences assembled daily and in each case the entire audience exposed jointly to an all-embracing risk, a condition is presented that has no counterpart in other types of building. It is a condition that justifies alarm—at any rate such degree of alarm as will inspire a careful study of existing theaters.

In the routine of daily life the public mind takes no notice of this special hazard. Not only the public but engineers and architects also tend to ignore it. Yet the fundamentals of their planning are (or should be) determined by it, and it is their obligation to take it into proper account. The question presented is whether the greater risk demands increased safety provision in theater construction: lower stresses, greater security of connections, and integration of structure.

Heretofore it has not been thought necessary to provide this greater safety. Implicity, the engineer as well as the layman takes the view that safety is marked off from danger by a clearly defined line, and that a safe construction is equally safe no matter how great the stake at issue. This view is in conflict with the rule applied to all other affairs of men, which exacts a special guarantee where special risk exists—even to the extent, for example, of requiring a better grade of rope for hoists than for derricks, because the life hazard is more direct in the former. Is the rule not applicable equally to the special hazard of the theater? Engineers and architects must answer the question.

An additional special hazard of theater construction must be reckoned with in answering the question. This hazard arises from the speculative character of the theater business—or perhaps from the makeup of the men engaged in it. Theater owners are not lavish in their expenditures when erecting their buildings, except on decoration and luxury items. They are satisfied with the law's strict minimum, and cases are not unknown where they urged economy on their architects and engineers even at the cost of building less safely. That the speculative builder, who has made his bad record in many a city, is a special hazard to safety, is recognized by the more severe building laws that his work has made necessary; if the theater owner is a similar source of special hazard, the argument for increasing the safety requirements on theaters is strengthened.

In bringing such questions to a focus the public alarm over the Knickerbocker accident is justified by its effect. It will justify itself still more if it will bring about a general investigation of the numberless makeshifts now doing duty as theaters—the ancient meeting halls or barns converted into "theaters" by the addition of an electric sign. Those structures, whose relation to the engineer or architect is commonly reflected in their fearful and wonderful roof constructions, represent a hazard of far greater total, we fear, than that of the theaters discussed in the preceding paragraphs. If every one of these improvised theaters in the land were now subjected to competent examination, the terrible cost of the Knickerbocker collapse would be in part, at least, repaid.

National Credits for a National Crisis

JUST NOW, while many are prone to look overseas for the answer to our economic problems, American business men might well paste in their hats the following statement by the Secretary of Commerce:

"We talk glibly of giving billions of credits to foreign countries to increase our farm exports. I wish to say with all responsibility for the statements that a billion dollars spent upon American railways will give more employment to our people, more advance to our industry, more assistance to our farmers, than twice that sum expended outside the frontiers of the United States—and there will be greater security for the investor."

In this and other recent statements Mr. Hoover has shown clearly the vital bearing of the railroad problem on that of business in general. His analysis has been incisive; his proposals, specific and clean-cut.

The fundamental necessity of the country today the Secretary considers to be the resumption of adequate maintenance, betterment and expansion of the railroads. Until they have been restored to an efficient basis private capital will not be forthcoming for new construction and new equipment. Unless both of these shall have been provided before the return of normal business, confusion and waste are bound to ensue. The roads will not be in shape to take up their share of the burden and instead of helping the productive industries will be competing with them for the necessities of industrial life. Mr. Hoover believes that unless we can have an immediate resumption of construction and of equipment expansion and betterment, the commercial community will pay treble their cost in the losses of a single season.

How, then, shall we begin? A general rate increase, he believes, is unthinkable. Neither can we fall back upon a general cut in rates to stimulate greater volume of traffic. That would mean confiscation. The Secretary believes that strict economy in operation accompanied, if necessary, by increased rates in some instances will make possible the reduction of rates on the primary commodities.

This is sound thinking.

But the greater need, the restoration of credit, Mr. Hoover would accomplish through the use of government credit; by guarantee of securities, but not by advancing government funds. A courageous program of betterments based on this substantial foundation would give relief to 500,000 to 600,000 of our unemployed, would raise the standards of living of many more and would broaden the markets of our farmers. But most of all it would enable our railroads in the days ahead to fulfill their mission as indispensable servants of prosperity.

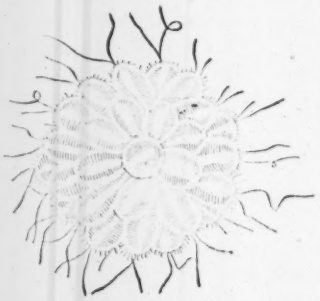
Of the many public services that have been performed by Mr. Hoover this clear-headed analysis of a critical national problem is not the least valuable. In normal times the use of government credit to aid private enterprise would be alien to the spirit of our institutions and should be discouraged. But in the face of a crisis such as that facing our railroads, arising largely from a blight on private credit, the use of national credit (without public expenditure) is a logical remedy, wholly in the public interest.

Synura and Other Organisms in Catskill Water Supply

Experience with Various Taste and Odor Producing Organisms Reviewed—Recent Trouble with Synura Controlled by Use of Copper Sulphate in Aqueduct and Reservoir and by Excess Chlorination

BY WILLIAM W. BRUSH
Deputy Chief Engineer, Department of Water Supply, Gas & Electricity, New York City

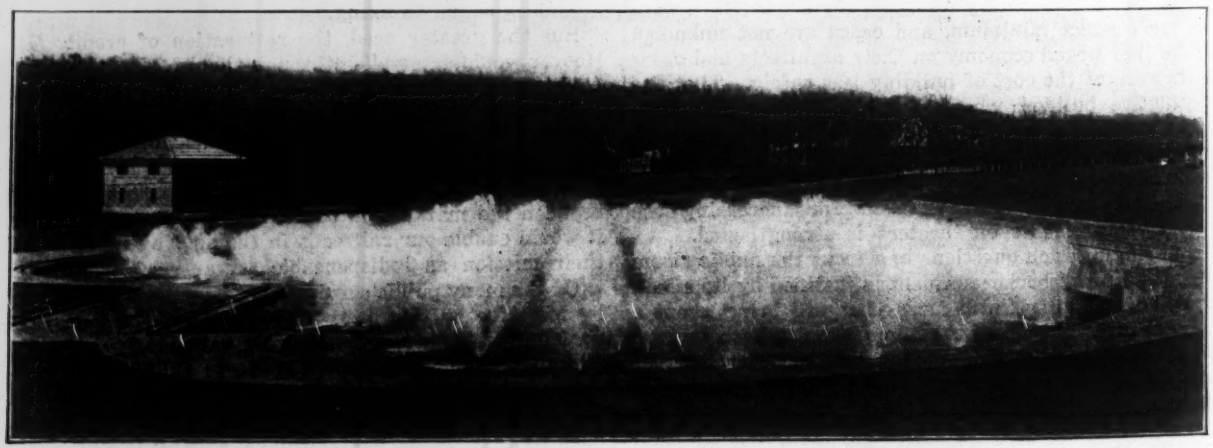
Growths of micro-organisms in the Catskill water supply, New York City, have reached such numbers from time to time since the aqueduct was put in use as to demand attention from the Department of Water Supply but until very recently the organisms have been controlled by throwing a reservoir out of use or by copper sulphate treatment without coming to the notice of consumers. Besides Synura, which caused the taste and slight odor to the prevention of which this article is primarily devoted, the predominating organisms have been Asterionella, Tabellaria and Aphanizomenon. The distribution of Synura in the recent experience was such that it could not be controlled by shutting off reservoirs but a combination of copper sulphate and excess chlorine was effective. The efficacy of excess chlorine in reducing taste is notable because at the outset the bad taste was caused by the normal chlorine dose, and it has generally been thought that chlorination strengthens a bad taste, as has been found true elsewhere, in water receiving waste coal tar products.—EDITOR.



SYNURA: MUCH ENLARGED
Redrawn from Whipple's "Microscopy of Drinking Water."

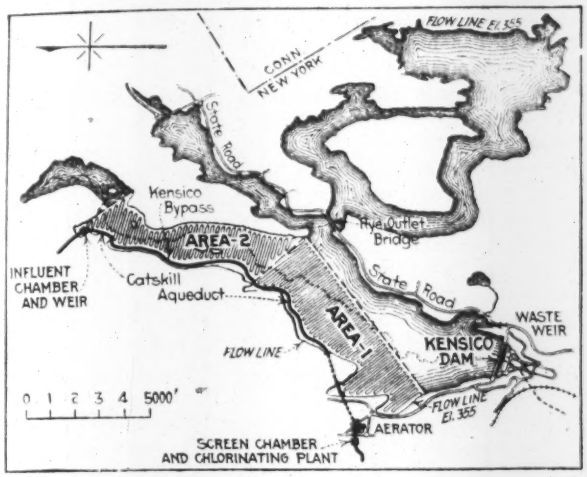
THE press of New York City has recently voiced in daily articles the unsatisfactory condition of the Catskill portion of the city's water supply due to a pronounced taste and slight odor. The taste has usually been designated as resembling a ripe cucumber, although many have designated it as "fishy," and this taste has created in the minds of the consumers a suspicion as to the purity of the water supply. The newspaper comments, the city health department, and the water department, have emphasized the harmlessness of the microscopic organisms, and their oil, which produces the taste complained of, the microscopic organisms being one of the protozoa group known as Synura. The consumer is interested in the possible effect the microscopic organisms have on his health, and in the elimination of the tastes and odors produced by the presence of these organisms, while the engineer is mainly interested in determining how the growths can be controlled and the tastes and odors removed from the water supply. The story of the microscopic organisms in the Catskill water supply system, and the unusual and successful methods of applying copper sulphate and chlorine to destroy not only these organisms but also the tastes and odors resulting therefrom, will be of interest to all water-works engineers and operators and helpful to many who have similar problems to solve. A brief outline of those features of the Catskill system which are pertinent to this subject will be given.

Outline of the Catskill System.—The Ashokan reservoir with a capacity of 130 billion gallons is the only storage reservoir on the Catskill (Esopus) watershed, and from this watershed there is an average flow of about 375 m.g.d. The reservoir is divided into two separate basins. The west basin, which furnishes about 40 per cent of the total storage capacity, receives virtually the entire stream flow, and the excess water passes over a dividing weir into the east basin, where it is stored until drawn for consumption. Water may be drawn from either basin at any desired depth, up to a maximum of 80 ft. with full reservoir. An aerator, with



KENSICO AERATOR WITH SCREEN AND CHLORINATION HOUSE ON THE LEFT
There is an aerator at the Ashokan dam also. Each aerator is equipped with some 1,600 nozzles.

some 1,600 nozzles, is located immediately below the reservoir and is operated except during the severe winter seasons. The aqueduct extends for 75 miles to the influx chamber of Kensico reservoir, and in this section



MAP SHOWING PORTION OF KENSICO RESERVOIR TREATED WITH COPPER SULPHATE

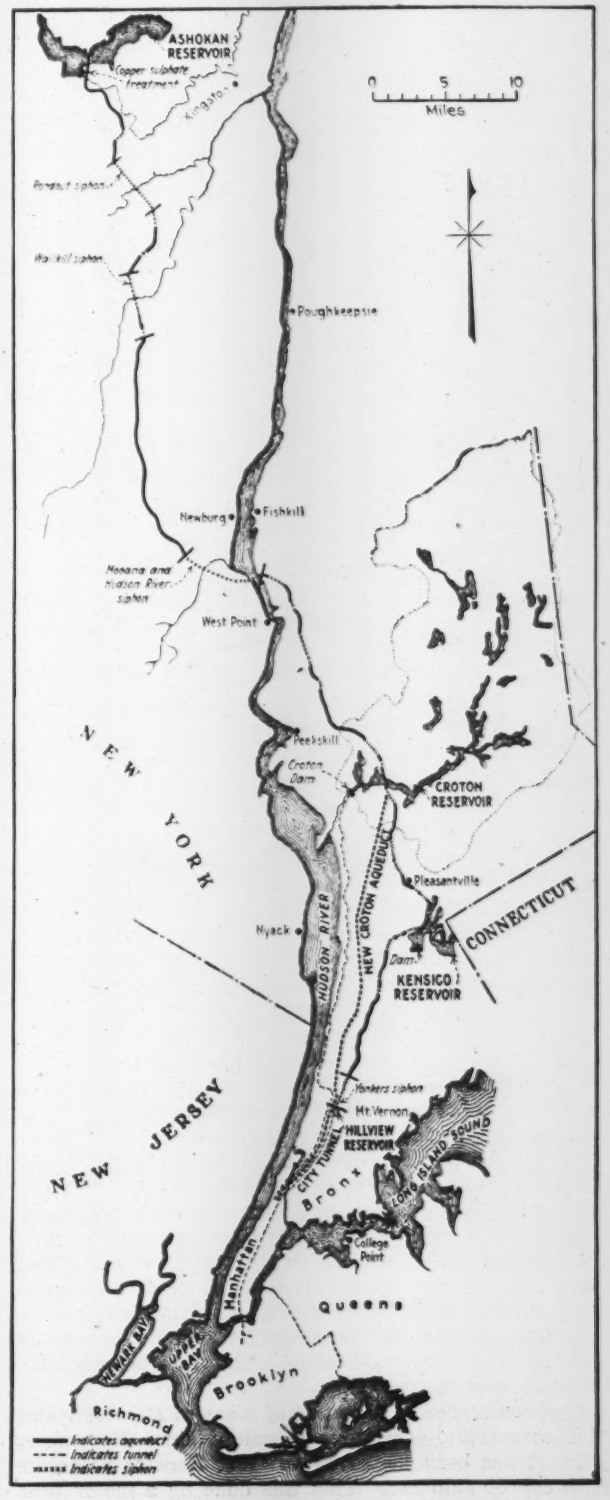
of aqueduct there are four deep pressure tunnels having an aggregate length of 15 miles, the deepest tunnel, that beneath the Hudson River, being under a maximum pressure of nearly 700 lb. per square inch. On this section of aqueduct, about two miles above Kensico reservoir, is the Pleasantville treatment plant, designed for the introduction of a coagulant, if such be required. A bypass aqueduct forms a connection between the Catskill aqueduct from points respectively just above and below the influx and efflux chambers of the Kensico reservoir, the length of the bypass aqueduct being about 2½ miles.

Kensico reservoir is a storage reservoir, designed to safeguard the continuity of the supply from the Catskill system, and has an available capacity of 30 billion gallons, with a total tributary watershed of only about 20 square miles. Just below the Kensico efflux chamber is an aerator, which is similar to the Ashokan aerator, and immediately below the aerator is a screen chamber in which is located a chlorination plant of the solution-feed type. The aqueduct from Kensico to Hillview reservoir is 14 miles in length, the lower 3½ miles being a pressure section, but the pressure in this section is only about 60 pounds.

Hillview reservoir is a distribution basin 35 ft. in depth and contains 900 million gallons. From this reservoir the city tunnel extends for 17 miles through the Bronx and Manhattan to Brooklyn, with a connection approximately every mile between the distribution system and tunnel. The average pressure in this tunnel is over 100 lb., with a maximum of 400 pounds.

The Catskill system supplies 400 m.g.d. out of the 685 m.g. delivered from the municipal sources. This system was placed in operation in 1917. The Catskill water had been considered an unusually satisfactory one, due to its clearness, pleasant taste and softness.

Microscopic Organisms in the Catskill Supply.—Previous to the present trouble with Synura, the consumer did not know that microscopic growths frequently developed in large numbers in this supply, and that they had been excluded from the water delivered to the consumer by changing the draft from the Ashokan basins, and by the application of copper sulphate either in Kensico reservoir or in the aqueduct at Pleasantville.



GENERAL PLAN OF CATSKILL AQUEDUCT AND RESERVOIRS

Only the principal siphons are indicated by name.

When microscopic organisms in objectionable numbers were present in Kensico reservoir and not in Ashokan reservoir, the practice has been to use the bypass aqueduct and shut off the Kensico reservoir, thus delivering the water direct from either of the Ashokan reservoir basins to Hillview reservoir. At all times the chlorination plant at Kensico has been used. The record of the bypassing of Kensico reservoir since 1918 is as follows:

Year	Period Reservoir Was Bypassed	Predominating Organism
1919	March 8—June 12	Tabellaria
1919	July 2—Sept. 20	Aphanizomenon
1920	May 14—May 22	Asterionella
1921	March 24—Apr. 16	Asterionella
1921	April 22—April 27	Asterionella

When organisms were present in one basin of the Ashokan reservoir and not in the other, the basin holding satisfactory water could be drawn on. When organisms in an objectionable number were present in both basins the flow in the aqueduct could be treated with copper sulphate at Pleasantville, and discharged into Kensico reservoir, or through the bypass. The periods during which treatment was carried on at Pleasantville were as follows:

Period of Treatment	Microscopic Organism Causing Treatment	Method of Delivery of Water
1920		
Jan. 3—Feb. 3	Asterionella	To Kensico reservoir
Feb. 27—Mar. 19	Asterionella	To Kensico reservoir
May 14—May 22	Asterionella	Through Kensico bypass
May 22—June 2	Asterionella	To Kensico reservoir
June 8—June 15	Asterionella	To Kensico reservoir
Sept. 25—Oct. 7	Tabellaria	To Kensico reservoir
1921		
April 22—April 27	Asterionella	Through Kensico bypass
April 27—May 12	Asterionella	To Kensico reservoir
Dec. 30—Dec. 31	Synura	To Kensico reservoir
1922		
Jan. 1—Jan. 5	Synura	To Kensico reservoir
Jan. 5—Jan. 8	Synura	Through Kensico bypass

Influence of Storage in Hillview Reservoir on Removal of Tastes Produced by Effect of Chlorination on Microscopic Organisms.—In February and March, 1919, various complaints were received of an unsavory taste and odor in the Catskill water, these complaints coming chiefly from the borough of Manhattan, but to a slight extent also from the boroughs of Brooklyn and Richmond. The complainants generally indicated that there was a "fishy" taste to the water, but investigation showed that this was not due to fish, although in certain sections numerous fish were found present in the water. The fishy taste was traced to a microscopic growth, Tabellaria, which was present in the water to the extent of 700 to 1,000 units per c.c. Ordinarily this number of Tabellaria would not produce a noticeable taste, and the development of the taste in this instance followed chlorination. It is believed that the action of the chlorine resulted in the breaking up of some of the organisms and the setting free of the oil contained therein. At this time the taste was eliminated by utilizing the one to two days' storage available in Hillview reservoir, this reservoir having previously been bypassed. When the Synura, under similar conditions of chlorination, caused the taste in December, Hillview reservoir, which then also was being bypassed, was put back into service with the expectation that a similar elimination of the taste in the water would follow. The anticipated result, however, was not realized.

Copper Sulphate Treatment of Kensico Reservoir and at Pleasantville.—On three occasions since November, 1919, it has been necessary to treat Kensico reservoir with copper sulphate. This was done by a motor boat travelling over the area to be treated along parallel lines about 100 ft. apart, and putting into solution sufficient copper sulphate to give to the water the proportion of copper normally considered necessary to kill the organisms then present. About three tons of copper sulphate have been used in each treatment, and the area treated was one-half the width of the reservoir from a point just above the influx chamber to a point just below the efflux chamber. This partial treatment of the reservoir has been uniformly successful in destroying the organisms, and no troublesome after-growths due to the treatment have been noted. The water coming from Ashokan has been treated in the aqueduct at Pleasantville, following the treatment of Kensico reservoir, until the organisms to be destroyed had virtually disappeared from Ashokan reservoir. At the Pleasantville plant about 400 to 600 lb. of copper sulphate were daily automatically fed into an aqueduct flow of 370 to 400 m.g.d. By using automatic feed no attendants were needed during the night shifts. The copper sulphate was discharged into a wooden container suspended in the aqueduct so that the flow of the water would dissolve the copper at the fixed rate of feed. The examination of the water in Kensico reservoir in the treated area between the influx and efflux chambers, made while the aqueduct flow was being treated, always showed that the organism was destroyed in this area. It is believed that prior to December, 1919, when Kensico reservoir was first treated, no large deep reservoir had been thus treated to destroy the microscopic organisms, although the treatment of portions of reservoirs having shallow flowage for the destruction of microscopic organisms had been successfully carried on for years past in the Croton system and elsewhere.

Copper Sulphate Treatment at Pleasantville with Kensico Reservoir Bypassed.—In the Spring of 1920 the simultaneous growth of Asterionella in the Ashokan and Kensico reservoirs made it necessary to bypass the aqueduct flow from Ashokan reservoir, while the Kensico reservoir was being treated with copper sulphate. In April, 1921, Asterionella again were treated by copper sulphate with the Kensico reservoir bypassed. In each case the copper sulphate was applied to the water in the Catskill aqueduct at the Pleasantville plant, and the Asterionella were destroyed, and any taste in the water eliminated in the passage of the water through the aqueduct to Hillview reservoir, and through this reservoir. The successful treatment of these organisms in this manner formed a basis for the similar treatment of the Synura, which treatment proved unsuccessful, as hereafter outlined.

One of the Lowest Forms of Life

Conditions Under Which Recent Objectionable Tastes Developed from Synura.—Synura, which is a protozoa, and therefore one of the lowest forms of animal life, was first noticed in the Ashokan reservoir in August, and varied from about 20 to 125 units up to the end of the year. It had been present in this reservoir in small numbers in 1918, 1919 and 1920, but had disappeared without causing trouble. As it was known that the oil given off by the Synura is a most penetrating and disagreeable one, the weekly microscopic examinations of the water entering Kensico reservoir, as well as the water in this reservoir, were watched to determine whether the organism was broken up and destroyed by the Ashokan aerator and the subsequent 75 miles travel through the aqueduct. This appeared to be the case, as no Synura were found, and previous experience (1918, 1919 and 1920), indicated the improbability of its de-

velopment in the reservoir. The sample of the water leaving the reservoir, used for microscopic examination, was taken just below the chlorination plant and the chlorine treatment was probably in part responsible for the Synura not being found in the samples as examined weekly.

On Dec. 8, 1921, complaints of a "fishy" taste in the water were received in Manhattan from persons residing in the area served by Catskill water. These complaints were believed to be due to stagnation, and the hydrants

MOTOR BOAT WITH COPPER SULPHATE DISTRIBUTING BAGS MOUNTED ON EACH SIDE AND STORAGE BOX BETWEEN

were blown off. On Dec. 21 and 22 several complaints were received, also of a "fishy" taste. Special examinations were made, which resulted on Dec. 29 in the location of from 60 to 100 units of Synura per c.c. in the Kensico effluent water before chlorination, but very few units after chlorination.

The Synura had not given serious trouble in the New York supply for fifteen years or more before this winter, and it was considered that about 300 units per c.c. would be necessary to give a noticeable taste or odor. It was therefore a surprise to find a distinct taste from so few units. It was found that the application of the chlorine was immediately followed by the appearance of the cucumber and bitter taste in the water, which was entirely free from such taste before chlorination. It therefore appeared that the chlorine intensified the taste produced by the organisms, and that was thought to be the explanation for so few organisms causing complaints.

When the taste was determined to be due to Synura, the ice had formed in the Kensico reservoir so that copper sulphate treatment could not be applied. The operation of the aerator at Ashokan had been stopped, due to ice, and the Synura were then going into Kensico from Ashokan. On Dec. 30 treatment with copper sulphate was started at Pleasantville, and the treated water delivered into the Kensico reservoir. The complaints became more numerous from the consumers in Manhattan and the Bronx, and on Jan. 5, as there were more Synura in the water coming from Kensico than in that from Ashokan, the Kensico reservoir was shut off and the aqueduct flow bypassed, treatment being continued at Pleasantville. The Pleasantville plant treatment was destroying the Synura, and it was believed, based on previous experience with the Tabellaria and Asterionella, that the taste of the oil would be dissipated before the treated water reached the consumer. The water travelled about six hours in the aqueduct after treatment, and then through Hillview reservoir, where the average time of passage was from one to two days. At the end of three days it was evident that the Pleasantville treatment had resulted in the water entering Hillview having a strong taste and odor, the Synura odor being plainly noticeable from the reservoir bank, and the taste was still decided when the water left the reservoir. The Catskill consumers in the Bronx, Manhattan and Brooklyn, who lived within a mile or two of the delivery tunnel, found the taste strong and very objectionable. Those living at greater distances did not get so strong a cucumber taste, but it was generally objectionable. This cucumber taste was removed by boiling the water in an open vessel for ten minutes, but such boiling did not eliminate the slightly bitter taste.

On Jan. 8 the treatment at Pleasantville was stopped, the aerator at Kensico shut down and the chlorine applied reduced from about 0.3 to 0.1 p.p.m., these changes being made to reduce temporarily, as far as possible, the destruction of the organisms and the resultant taste. A reduction in the taste of the water leaving Hillview reservoir from a strong to a faint or mild cucumber flavor followed, but as was expected, the live organisms broke up in the distribution system, causing strong taste in some locations.

Experiments to Remove the Synura Taste.—A 16-hr. test was started on Jan. 11 by applying copper sulphate at the rate of 400 lb. per day at the Ashokan screen chamber, to determine whether the oil from the Synura would be largely eliminated by the extra 75 miles of aqueduct flow.

Several years ago an unsuccessful attempt was made to kill a growth of Aphanizomenon in the Croton reservoir, by adding a solution of copper sulphate to the water in the aqueduct at Croton Lake gatehouse, and it was therefore considered that possibly the daylight might be needed to kill the microscopic organisms after the copper sulphate was introduced in the water, but this evidently is not correct. Samples of the treated

INTERIOR OF PLEASANTVILLE TREATMENT PLANT

At the center of the view is a barrel of copper sulphate, placed over a movable shutter through which any desired quantity of copper sulphate is automatically fed into the aqueduct below.

water taken at Kensico gatehouse just above the aerator showed that the Synura had been decreased from about 100 units per c.c. to about 40 units, that those remaining had lost their chlorophyl, and that the cucumber taste was decided. The cucumber odor was strong around the aerator and the taste of the water below the aerator was mild. The taste was not increased by the chlorine treatment, using 0.3 p.p.m. of chlorine. On Jan. 14, after the results of this test were determined, the application of the copper sulphate at Ashokan was resumed, and the taste of the water leaving the Hillview reservoir became

mild, and this taste was almost wholly dissipated by the time it reached many of the consumers, as it gradually reduced as the water traveled farther from the reservoir. The microscopical examination of the water leaving Hillview reservoir showed only about 5 to 10 dead Synura units.

Increase in Chlorine Dose Removes the Taste.—On Jan. 17 a test was made of the effect of an increase in the dose of chlorine on the taste of the Synura oil. To make this test the flow through the aqueduct was temporarily reduced to 160 m.g.d. and the chlorine application continued at the maximum capacity of the plant. This gave a chlorine application of about 0.73 p.p.m. and a sample taken about 1,500 ft. down stream from the point of chlorine application and tested 15 minutes after collection showed the Synura taste to be reduced and a combination Synura and chlorine taste to be present. When this higher chlorine treated water reached the uptake shaft at Hillview reservoir, about eight hours later, there was a slight chlorine taste, but the cucumber taste of the Synura had disappeared. The slight bitter taste from the Synura, which would be noticed by but few consumers, was still present. In addition to the Synura there have been about 700 units of Asterionella present, which have also been destroyed, but this number is not sufficient to give the Asterionella taste, which is also objectionable. Whether the excess chlorine oxidizes the Synura oil, or forms a tasteless compound, is not known, but whatever may be the chemical reaction the important factor for water-works operators is the removal of the taste. The duration of the experiment was not long enough to prove conclusively that the taste would be removed if more Synura units were present, but the results are certainly encouraging. Sir Alexander Houston in his 1920 annual report on the London supply, points out the possibility of removing certain tastes produced by chlorination by increasing the excess chlorine, and the writer understands that in one or two instances in this country organisms causing a disagreeable taste have been destroyed, and the taste also removed by an increased dose of chlorine. Further experiments along this line should be interesting and instructive.

Ortho-tolodin Test for Free Chlorine

Increase in Absorption of Chlorine.—Since July, 1921, the amount of chlorine applied to the Catskill and Croton waters has been based upon the additional free chlorine shown by ortho-tolodin test made on the raw water and on the treated water 30 minutes after the chlorine is applied. The standard increase in additional chlorine was fixed at 0.1 p.p.m. Up to the middle of August the Catskill water showed a low absorptive capacity for the chlorine and the excess of 0.1 was secured with a total dose of 0.22. Since then the absorption of chlorine has rapidly risen and it has been found impossible to maintain the desired excess of 0.1 of a part. During the brief test while the aqueduct flow was reduced, the absorption of chlorine was 0.45 p.p.m., or about four times the absorption last Summer. That the microscopic organisms may cause this increase is not unlikely. It would appear from the slight data available that the destruction of the Synura taste may be accomplished with a free chlorine increase of approximately the standard of 0.1 of a part.

The department has ordered an increase in chlorine feeding equipment for the Kensico plant, which, when installed, will permit 0.8 p.p.m. of chlorine to be added to the Catskill water with a 400 m.g.d. flow, and expects to have this plant ready for use soon.

Reduction in Number of Synura in Ashokan Reservoir.—On Jan. 20 the draft at Ashokan was changed from the east to the west basin, as two or three days previously there had been a rapid increase in the Synura in the east basin and a corresponding decrease in the west basin. This change reduced the number in the water, as drawn, from over 100 units per c.c. to about 10 units per c.c. There is a very slight taste in the water from this small number of Synura as it enters Hillview reservoir.

Excess Chlorine Neutralizes Synura Oil

Increase in Amount of Copper Sulphate Applied.—On Jan. 18 the amount of copper sulphate fed into the aqueduct at Ashokan was increased for eight hours to the rate of 600 lb. per day and then, for a second eight hours, to 800 lb. per day. No difference in taste could be noted when this more highly treated water reached Kensico above the chlorination plant. When the samples were taken at the uptake shaft at Hillview reservoir it was found that there was no taste in three samples taken two hours apart and representing the water treated with the copper sulphate at the rate of 800 lb. per day, or 2 lb. per million gallons. The chlorine treatment was at the rate of 0.3 of a part. The microscopical examination showed that the water treated at the 600-ft. rate had several intact but dead Synura colonies, while the water treated at the 800-lb. rate showed the organisms practically completely destroyed. The increase in copper sulphate apparently more promptly and thoroughly destroys the organisms, and thus fully exposes its oil to mechanical removal in the flow through the aqueduct and to the later chemical reaction with the chlorine at Kensico. The increase in the chlorine dose destroys to some extent the organisms, but its more important action appears to be a rapid neutralization of the Synura oil through a chemical process.

Treatment of the Croton Supply.—In the Croton system there is no large reservoir corresponding to Kensico reservoir, where the daily draft of Croton water could be treated by copper sulphate before being delivered into such reservoir. The only opportunity for treatment of the Croton supply is in the 26 miles of aqueduct connecting Croton Lake with Jerome Park reservoir, this latter reservoir being a distributing reservoir holding 730 million gallons, or about two days draft. If the results recently obtained with the Synura in the Catskill supply are confirmed by future treatment of microscopic growths, then it would appear that such growths developing in Croton Lake during the period when ice covers the surface could be successfully destroyed through the continuation of copper sulphate treatment of the water in the Croton aqueduct at the Croton gatehouse and the application of chlorine at the Dunwoodie chlorination plant, which is located about 3½ miles above Jerome Park reservoir.

Conclusions.—The conclusions that may reasonably be drawn from the experience with microscopic organisms in the Catskill supply are:

1. Microscopic organisms in Kensico reservoir may be effectively destroyed by treating that portion of the reservoir through which the flow usually takes place with sufficient copper sulphate to give the proper solution strength.

2. Continuous treatment of the flow in the aqueduct with copper sulphate will destroy the microscopic organisms.

3. The period of time required to remove the oil given off by the microscopic organisms varies, and with the Synura is more than two days.

4. No copper has been found in the supply as a result of copper sulphate treatment.

5. The addition of chlorine after the copper sulphate treatment did not increase the taste of the oil given off by the microscopic organisms but, on the contrary, did destroy the taste of the Synura oil when sufficient chlorine was added.

6. The addition of chlorine does destroy some of the microscopic units when these have not been previously destroyed by copper sulphate, and thus cause a release of the oil contained therein, with a resultant taste to the water. With a given microscopic organism the intensity of taste and odor imparted to the water through the addition of chlorine is dependent upon the number of units present and the amount of chlorine introduced into the water. The taste increases as the dose of chlorine is increased, until the maximum is reached, when probably the taste from the organism will decrease with further increase in the chlorine dose, although there may be a resultant excess chlorine taste.

7. A combination of copper sulphate and chlorine treatment of water high in microscopic organisms appears to be a satisfactory method of elimination of the organisms and their taste.

The writer wishes to acknowledge the excellent work done by Dr. Frank E. Hale, director of laboratories, in the water department, to whose efforts the solution of the New York City microscopic organism troubles is mainly due.

The water supply system of the city is under the Department of Water Supply, Gas and Electricity, Nicholas J. Hayes commissioner, with Merritt H. Smith chief engineer.

Since the foregoing statements were prepared we have made an experiment on chlorine treatment of the water from Kensico reservoir, delivering the water through the Bronx 48-in. pipe line and wasting it near the city line into the Bronx River. This experiment showed that there are about 50 units of Synura in the water going into the pipe line; that at a point 4½ miles below the dam we had no cucumber taste when using 0.5 p.p.m. of chlorine, and also none when using 0.7 and when using 0.75 of a part. We had a faint chlorine taste in about one-third of the samples taken 4½ miles below the dam, and only a hint of chlorine in one sample out of about a dozen taken 13 miles below the dam. This test corroborates the conclusion that excess chlorine would destroy the Synura and remove its taste, and indicates that even in a pipe line this may be accomplished without serious danger of objectionable chlorine taste.

Detroit Local Census Shows Less Population

According to a census taken by the authority of the Board of Education of Detroit, the population of the city as of June 1, 1921, was 942,373 or 51,305 less than the United States Census count as of Jan. 1, 1920. The number of unemployed males 20 or more years old on June 1, 1921, was 55,963.

Reminders for the Designer of Steel Structures

Cautions As to Corrosion, Expansion Effects, Future Extension and Rough Handling—Bracing and the Erector

BY R. FLEMING
American Bridge Co., New York

THE purpose of this article is to call attention to points in the design of steel structures that are sometimes neglected.

Conditions Favoring Rusting—The physical conditions surrounding a building have not always been considered. This accounts for some unfortunate choices of roof covering. For instance, ordinary black corrugated steel sheets were used for enclosing a copper refinery near the sea coast. Subject to gaseous fumes from within and unusual atmospheric conditions without, they corroded rapidly and had to be replaced in little more than a year. Galvanized sheets would have lasted longer, but not as long as the corrugated iron which was used the second time. In tropical climates corrugated iron is also to be preferred to corrugated steel but unfortunately the price usually prohibits its use.

FIG. 1. STEEL-MILL COLUMN PROTECTED BY CHANNELS

Differences in temperature and humidity between inside and outside should also be considered. An engine room visited on a cold winter's morning comes to mind. The temperature in the room was 75 or 80, and the engine and floor were wet with the condensation that had dripped from the under side of the corrugated metal roof above. A metallic roof covering that has good fire-resisting qualities, that is rust- and waterproof, and that does not gather condensation on its under side, is a material greatly needed.

Neglect of Expansion—Occasionally provision for expansion and contraction has been neglected where it was needed. Greater liberties can be taken in this matter with steel buildings than with steel bridges. Roof trusses resting on walls have been used without roller bearings even for spans up to 100 ft., and in fact the writer has used them up to 120 ft. Where trusses are supported by steel columns the span may be increased almost indefinitely without attention to expansion. The 236-ft. trusses on columns 55 ft. high (illustrated in *Engineering News-Record* of May 8, 1919, p. 898) of the rolling mill of the Crucible Steel Co., have no provision for expansion and no trouble has ever been reported. Buildings and crane runways have been built 600 ft. and more long without any provision for expansion save that the ends were free to move, that is, not confined by any adjoining structure.

Little has been published on the effect of longitudinal expansion in buildings and crane runways. It is doubtful if the length of a runway that is free to expand or contract only by tipping columns should exceed 300 ft. The point needs special consideration about furnaces and where wide variations of temperature may occur.

One crane runway more than 1,000 ft. long, with girders throughout riveted together end to end, had to have expansion joints inserted the first summer of

its use. The same thing was needed in another crane runway, about 1,200 ft. long, whose girders on one side were supported by the columns of a steel-and-concrete pier shed having large doors in its side. The doors worked all right in the morning, but when the sun came up the girders expanded and drew the columns with them, so that the openings near the ends were no longer rectangular. The doors for these openings could not be closed until some time in the evening, after the girders had become cool and the openings had resumed their rectangular shape. The insertion of expansion joints proved an effective remedy.

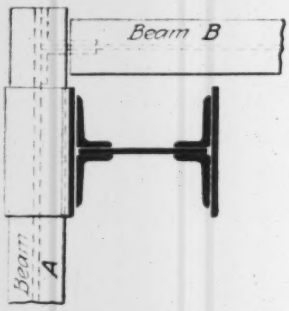


FIG. 2. CANTILEVER FRAMING IN PLACE OF COLUMN BRACKET

Future Extension—The probability of future extension is a point that should be well considered in designing a steel structure. If it is probable that in a few years more stories will be needed for an office building, the columns should be designed to carry the future loads. If it is likely that an overhead traveling crane will sometime be wanted in an industrial building, the building should be high enough and strong enough for it. Provisions such as these can be made in the original building at a small fraction of the cost of doing so later. About all that is required to provide for the future lengthening of an industrial building is that the end trusses be made as strong as the intermediates, that purlins be stopped at the center of end trusses, that connections for end framing be bolted, and that a few extra open holes be provided.

Designers have sometimes neglected the local building code, to their sorrow. In one such case—a many-storied office building—the detail drawings were finished and the work partly fabricated when the building department decided that changes should be made to conform to their code. This was done at heavy expense to the owner.

Emergency Conditions—Some parts of a structure may be subjected to rough handling, and this possibility should not be altogether neglected. A runway for a heavy crane in a steel mill is now being built. Fig. 1 shows at *A* the section of column first intended to be used. But workmen are not always careful and heavy loads from the crane are liable to strike the columns. Moreover, in this particular mill workmen have been known to strip the mold from the ingot by bringing it three or four feet from a column and then swinging it until it struck, thus jarring it loose. The column section was changed to that shown at *B*, a section preferable for all columns that are liable to be struck by crane loads or passing trucks.

FIG. 4. MILL BUILDING COLLAPSE CAUSED BY NEGLECT OF BRACING

Impact stresses—not those from moving loads as much as those from special conditions—are sometimes neglected. In designing sugar mills the stresses from vertical loads on vacuum-pan floors should be increased not less than 50 per cent for impact. The agitation of the contents of these pans when boiling is terrific. In one sugar mill the failure to make proper provision for it necessitated strengthening the structure after erection.

A heavy shell once fell from a gallery in a gunshop to a floor below and striking about midway between two beams passed through the 10-in. concrete slab, leaving a hole as if cut with a sharp knife. J. W. Ledoux in an article, "Dangerous Stresses from Falling Bodies in Floors," *Engineering News-Record*, April 29, 1920, p. 873, gives a formula for determining flange stresses in beams from falling weights. A slightly different formula is given in the Carnegie "Pocket Companion." The stresses are greater than usually supposed. For a weight of 100 lb. dropped from a height of 1 ft. on the middle of a 12-in. 31½-lb. I-beam 16 ft. long between end supports, the flange stress is 13,600 lb. per sq.in. according to the Ledoux formula and 13,025 lb. per sq.in. according to the Carnegie formula. If dropped from a height of 5 ft. the corresponding figures are 30,350 and 28,560 respectively. For a weight of 1,000 lb. dropped from a height of 1 ft. on the same 12-in. I, the flange stresses are 43,925 lb. per sq.in. according to the Ledoux and 43,330 lb. according to the Carnegie formula. It would be impracticable to design beams for possibilities of weights dropping upon them but every precaution should be taken to prevent weights from being dropped. Galleries and platforms should have guard angles. Trucks and cars should have their loads so secured that they will not fall off by any little jolt.

FIG. 3. TOWER BRACING OF ROOF

Eliminating Roughness—The causes of impact can sometimes be eliminated. A striking case is that of the ordinary highway bridge. As the bridge engineer of the Wisconsin Highway Commission says, ("Assuring Safety in Old Highway Bridges," *Engineering News-Record*, Jan. 13, 1921, p. 61), "Just so sure as a rough bridge floor will cause a large amount of shock, stressing the bridge far beyond a static load of the same weight, so will removing the cause of impact tend to relieve the bridge. . . . The approaches to any bridge can be placed in such a condition that the loads will roll upon the bridge smoothly and not, as is often the case, land on it with a bang that can be heard half a mile away." Similarly readjustment of shafting or a leveling of crane rails can often be made that will lessen vibration and impact.

Lateral Stiffness—The lateral stiffness of crane girders is a point upon which every fabricating firm has gained knowledge by costly experience. Probably every maker of traveling cranes has been obliged to strengthen the bridge girders of some crane after erection was completed. Walkways are now being made of steel and the loads thereon are heavier than formerly, thus producing a greater torsion on the carrying girder which if ignored is liable to give trouble.

Small Stresses and Secondary Effects—"Never neglect a stress because it is small," was the advice given by C. Shaler Smith to one of his office force. Before neglecting any stress some idea should be had of its nature as well as its magnitude. A long member subject to both compression and bending is often stressed to its limit and should have no additional stresses even if they are small. In many cases small stresses may safely be neglected.

Secondary Stresses

Secondary stresses brought about by eccentric loading and eccentric riveted connections should receive attention. Their effect has at times been exaggerated in books and articles; often they have been neglected in practice. They certainly should not be ignored. In the revision of an architect's design the effect of the eccentric loading on a corner column was greatly lessened by the use of the cantilever (Fig. 2); beam B, instead of being attached to a bracket on the column as shown by the architect, was framed into beam A extended. Similar devices can often be used.

Bracing—So much has been written regarding the bracing of buildings that anything more on the subject may seem superfluous. Yet adequate bracing is still lacking in many buildings. No system of bracing is complete unless wind and vibration stresses are carried to the foundations. Otherwise it is not a system but an aggregation of braces.

In planning bracing the erection of the building should be kept in view. Most erectors for buildings of any great magnitude prefer that two trusses at each end be braced together as a tower, thus enabling adjustments to be made in intermediate portions by pulling on the tower. Fig. 3 shows the roof of a building so braced.

Several years ago a building was being erected with the idea of gaining time by leaving the bracing until last. Work was proceeding rapidly until one afternoon a gust of wind struck the steel frame, causing its collapse, as shown in the view Fig. 4.

Neglect on Side of Safety—Some neglected points in structural design make for safety. The loadings prescribed in building codes and specifications are usually greater than those liable to occur, and the working stresses in common use are somewhat low. The time-honored 16,000 lb. per sq.in. for tension could safely be increased to 17,000 or 18,000, if steel fulfilled standard specifications and good workmanship was assured. In the column formula, $S = 16{,}000 - 70\ l/r$, Schneider considers the effective length l, as compared with the length L of the member between centers of connections, to be $l = L$ for both ends hinged or butting; $l = \frac{1}{2} L$ for both ends fixed; and $l = \frac{2}{3} L$ for one end fixed and the other hinged. Columns are usually figured for $l = L$, even where end connections are fixed or partly fixed by riveting—an error on the side of safety. The indefinite frictional resistance of rivets is often in excess of the shearing and bearing values used in detailing. For power-driven rivets there is little reason why rivets driven in the field should not be counted equal in strength to those driven in the shop, though specifications assign them less shearing and bearing values. Again, shearing and bearing values of rivets are calculated from their nominal diameters. The holes are reamed or punched $\frac{1}{16}$ in. larger, increasing the shearing and bearing values in accordance with the degree of accuracy with which holes match each other when pieces are assembled.

It may be inferred that the reason why some structures stand is because "factors of safety" like the foregoing help counterbalance "factors of ignorance" found elsewhere. It is better, however, to eliminate the "factors of ignorance" as far as possible and design structures for the stresses actually to be sustained.

"Rolled Base" Endorsed for Brick Road Construction

FOR brick pavement construction, "rolled base," including one or more courses of crushed stone, gravel or slag, rolled and thoroughly bound with screenings, may be used successfully even under rather unfavorable soil and drainage conditions, according to the findings of A. T. Goldbeck, chief, division of tests, and F. H. Jackson, senior assistant testing engineer, U. S. Bureau of Public Roads, in a report covering an inspection of a number of brick roads of this type in Ohio. It is pointed out that the rolled base affords an opportunity for utilizing local materials in place of a more expensive concrete base. A bedding course, 1 to 2 in. thick, of sand, stone or slag screenings is usually employed, the prevailing thickness of the base course itself being 6 in.

Like every other pavement type, the report points out, best results have been secured when conditions make possible a firm, stable foundation at all seasons of the year, such as may be obtained with a sandy soil in a gently rolling country where satisfactory natural drainage may be secured. Under these conditions the rolled-base type is apparently giving satisfactory service even under heavy traffic provided a flexible wearing surface is secured by the use of a bituminous filler. This statement would seem to be justified by the behavior of the roads in southern Ohio, especially in the vicinity of Camp Sherman, where they carried very heavy traffic during the war. The 6-in. compacted gravel or stone bases of these roads seem to be adequate.

The national road in Muskingum County is an example of the rolled-base type under rather unfavorable soil conditions. Several samples taken along the road show that the soil grades about midway between the sandy soils of Ross County and the heavy clay soils of Trumbull and Cuyahoga Counties. The excellent natural drainage afforded by the rolling country through which the road passes is probably largely responsible for the fact that no major foundation failures have occurred. There are no closed depressions or swamps to hold the water in the subgrade and thus lessen its bearing power.

In northeastern Ohio a somewhat wider range of conditions is encountered. Probably the worst combination of poor soil and poor drainage with heavy traffic was observed in Trumbull County. Here the road ran through a very flat country permitting almost

no natural drainage, while the soil was a very heavy clay. In the face of such conditions, the report states, it is remarkable that the road has held as well as it has.

In summing up the results of their study, Messrs. Goldbeck and Jackson present the following conclusions:

"The rolled-base type, provided it is properly placed and compacted, is a suitable type for brick construction where soil conditions are favorable and good natural drainage may be obtained. Under these conditions a 6-in. compacted rolled base should be adequate, provided a 2-in. sand or screenings cushion is used.

"The rolled base may be successfully used under ordinary road conditions, provided the thickness of the base is adjusted to meet the probable traffic requirements. An 8 to 10-in. compacted base with an additional 2 in. of cushion should suffice under all but trunk line highways subjected to very heavy traffic.

"Whenever a rolled base is used a bituminous rather than a grout filler should be employed in order to provide a flexible section throughout.

"In general asphalt fillers are more satisfactory than tar or tar-mastic fillers, owing to the tendency of the latter either to chip out or flow in hot weather.

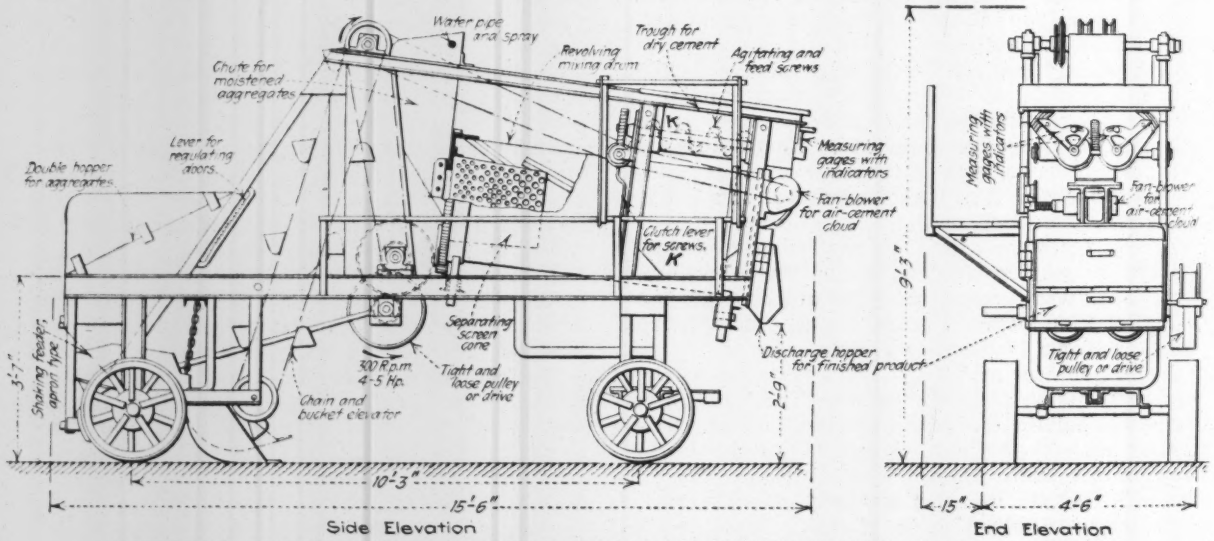
"Very inferior material, as measured by laboratory tests, may be successfully used as base material for brick roads."

New Type Continuous Concrete Mixer

FOR some years a new type of concrete mixer has been successfully used in Europe, mainly in Switzerland and France. It is continuous in action, but differs from other machines in that it provides precise measurement and proportioning of aggregate and that the already wetted and individually separated aggregate particles are passed through a cloud of cement blown in from the opposite end of a slow-rotating cylinder. The accompanying description and diagram were furnished by Joseph F. Shadgen, New York City, who is preparing to put the machine on the American market. The machine is known as the Aero mixer and is the invention of E. Springer. It is made by Couturier, Aebi & Co., Paris.

The diagram represents a machine with an hourly capacity of from 8 to 12 cu.yd. of semi-dry concrete. The aggregate is introduced at the left in the double hopper there, one part for the sand, the other for the broken stone. The hopper is equipped with a shaking apron feeder operated by a connecting rod from the main drive shaft. There are levers that open or close the two hopper-doors and thus proportion the absolute and relative quantities of the aggregates delivered to the boot of the elevator. This chain and bucket elevator lifts the coarse and fine ingredients some 10 ft. up into the steep chute that carries the sprinkler pipe which continually moistens the aggregates. The mixing drum, mounted in the middle of the machine, is provided with a short screen cone separating through its varying apertures the particles of the aggregate so as to facilitate their coating with cement. By the combined action of the plow blades inside of the drum and its inclined position together with the slow rotating movement the aggregate not only mixes thoroughly but also advances stepwise—by successive lifts and drops towards the discharge end.

The cement is emptied from the sacks or barrels into the trough at the right-hand upper end of the machine, and is constantly agitated and broken up by two screws feeding the dry powder to two measuring gages (provided with indicators, fingers and set screws) that positively proportion the amount of binding medium in the concrete. A fan blows into the mixing drum a constant stream of air loaded with the cement delivered by the screws. In this cloudy atmosphere saturated with the binding agent the aggregate repeatedly drops in its steady advance towards the discharge hopper.



CONTINUOUS CONCRETE MIXER IN WHICH AGGREGATE PASSES THROUGH CLOUD OF CEMENT

Work of Michigan State Sanitary Engineers

A summary of the work done in 1921 by the Sanitary Engineering Division of Michigan under the direction of C. M. Baker, state sanitary engineer, shows that of 185 investigations made, 115 or 62.1 per cent had to do with industrial wastes (as compared with 48.6 per cent in 1920); 44 or 23.8 per cent with sewerage and 26 or 14.1 per cent with water supplies. Of the industrial waste investigations, 93 or 50.3 per cent of all investigations, had to do with milk plants and 17 or 9.2 per cent with canneries.

What Industry Thinks of Engineering Education

Abstracts of Two Papers, Both by Industrial Executives, Read at the Recent Annual Meeting of the American Society of Mechanical Engineers

Professional Engineering Service for the Industries

BY FRANCIS C. PRATT
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WHILE familiarity with apparatus obtained from laboratory work coincident with undergraduate studies is of great value in giving the student more appreciative knowledge of his subjects, as are also frequent visits to, and summer work in, industrial establishments during the undergraduate period, yet I am confident that nothing which the colleges can give can take the place of the practical experience gained in the atmosphere of an industrial organization, bringing with it an intimate knowledge of both methods and men with which and with whom one's life work is to be associated. In my opinion the time in college is so valuable that it should be primarily devoted to those things which can only be acquired later with a great deal of difficulty. My observations also lead me to the conclusion that the percentage of those who fail to obtain a reasonable success is greater in the group of men of mediocre ability but narrowly specialized education than in almost any other group coming within my knowledge. Such men unless extraordinary vigilance is exercised by those in charge, become permanently attached to an organization doing specialized work for which they have no particular adaptability, clogging the opportunities for younger, more able, and progressive men to advance. It would have been far better for such a man if the head of the department had at the end of one or two years of employment, recognized the circumstances and frankly informed him that he was not likely to make a success in the professional work which he had undertaken, and advised him to enter into some other vocation.

TOO EARLY SPECIALIZATION

If I were to make a broad criticism of our methods of engineering education as they exist today, I should base it upon too early specialization of the student resulting in the turning out of a disproportionate number of men of the class to which I have just referred, that is, those of mediocre ability and narrow specialized education.

I should be disposed to strongly criticize another condition in our colleges which I recognize as an exceedingly difficult one to overcome, and that is, as the result of the high degree of standardization, induced perhaps by the numbers who have to be taught, the more brilliant men in the class are retarded in their progress by the requirements of a standard which can be met by the less capable student. If we are not only to attain, but also maintain, great eminence in the engineering professions in America, we should and I think must, devise some means whereby the more promising students can with greater facility advance with breadth and thoroughness in their work.

It is, I think, significant that in the organization with which I am in daily contact, a noticeable number of our most accomplished theoretical engineers and research laboratorians have either pursued post-graduate studies in European universities, or else have had all of their scholastic training abroad. This may suggest an opportunity for American educational institutions which is not fully met at the present time. In this connection I think that the colleges should resist the temptation to enter into specialized fields which are adequately covered by kindred institutions, and that better results would follow if, in general, each endeavored to maintain the strongest possible staff of teachers to give the most thorough instruction in the fundamentals of the sciences, engineering, economics and languages, and confine its specialization to such work as it is pre-eminently fitted to carry out.

The industries need administrative men well versed in the sciences and in engineering, in order that they may lend appreciative and sympathetic support to the technical developments, which are, in fact, the very life blood of the industry and on which its future primarily depends. That the colleges of the country are alive to this need, is evidenced by the number of courses which have in recent years been established, teaching the fundamentals of the sciences, engineering, economics and languages, and variously referred to under the names of administrative engineering, commercial engineering, or other courses.

A carefull study of a large number of college graduates employed at the several works of the General Electric Company indicates that our educational institutions are developing young men of real ability for the industry. The suggestion that is sometimes made to reduce the amount of cultural studies in order to specialize more intensively on technical subjects, is not viewed with favor.

The time in college is of such value that it should be primarily devoted to those things which can only be acquired later with great difficulty. At best, the student cannot hope to attain in college the well rounded knowledge and practical experience that are to be gained in an industrial organization.

A broad criticism of methods of engineering education is that it undertakes too early specialization of the student. Another is that lack of facility offered to the more capable student to advance rapidly.

* * *

Engineering Education as Viewed by the Industrialist

BY J. E. OTTERSON
President, Winchester Repeating Arms Co.

THE pedagogue is interested primarily in the process of education. The industrialist is interested primarily in its product. The student upon graduation, must pass from the supervision of the pedagogue to the critical survey of the industrialist.

It seems fair to assume that the purpose of education is something more than the mere acquisition of knowledge. The industrialist is obliged to look for something more. The student is likely to find upon graduation that those things which he has regarded as the purposes of the educational processes through which he has passed, now become only a means for the accomplishment of the real purposes of life. It is in developing this change of viewpoint that the student is likely to meet with disappointment, perhaps discouragement, and during this period the industrialist finds difficulty in adapting the student to his utilitarian purpose.

Knowledge is not of itself a qualification for large responsibility in industry. The encyclopedic type of mind which merely records impressions and facts brought before it may lack those qualities of imagination and initiative so essential to the accomplishment of practical things under adverse conditions, which do not always evidence strict conformity to the laws of governing recognized and recorded knowledge. Something more is required than that type of mind which is merely a reservoir containing a large amount of knowledge in a static state. Modern industry is dynamic and moves at a tremendous pace.

We want, therefore, the type of mind that will be immediately energized when the current is turned on; the motor type rather than the storage-battery, and when the individual progresses to larger responsibility he may be called upon to animate, magnetize and electrify other minds about him, and to develop the qualities of generation as well as those of motivity.

The Encyclopedic Mind

There are doubtless certain occupations in life where the possession of accumulated knowledge is both desirable and essential, but in industry this quality alone will not carry the applicant beyond the lower orders of subordination. He will take his place among those student clerical types that are the handbooks of industry; much thumbed and used and frequently showing signs of wear and tear and dilapidation; referred to for statement of facts or formulation of laws but in the emergencies of everyday life frequently passed by in the race for accomplishment. Such are not the positions in industry that are difficult to fill. The encyclopedic type is sufficiently common to meet the need and in the search for the type with initiative, vision, imagination and dynamic force, the industrialist must apply other methods than those of the school-room examination. The industrialist is concerned more with the effect of the educational processes upon the habits and character of the applicant than he is with the degree of learning which he has attained. The industrialist is interested in mental, physical and moral character rather than in pure intellectualism; more in the ability to acquire knowledge quickly through application and concentration than in the immediate possession of knowledge.

The habits of industry should have as their foundation the habits of the student who is preparing for industrial work. In passing from student life to industrial life he should be able to do so successfully by continuation of the habits he has acquired in his college training rather than by a radical change that places him in an unfamiliar environment of work and activity.

His college life should be something more than a mere signal drill. He needs the scrimmage and the actual game to develop his full qualities.

Without endeavoring at this point to place the responsibility, the college graduate who is an applicant for an industrial position all too frequently shows no knowledge of the work to be done in the field which he is about to enter. He evidences no particular desire, ambition or purpose and he has little knowledge of the direction in which he is going or desires to go. If an opening is offered him, he has no capacity of judgment as to his adaptability. He is generally quite willing to leave the question of his future work in life to the hurried determination of the industrialist, who in a ten-minute interview may attempt to analyze his character and assign him to a task in which all parties concerned hope that he may be successful. Obviously this is an uncertain and unscientific method of directing the human forces set free by college education.

Small wonder that so many find themselves in uncongenial employment, ending in discontent, perhaps discouragement, changing from one class of work and finally from one job to another without direction or control.

A force is defined by its magnitude and direction. I am not complaining as to the magnitude of this tremendous human force launched into the world with each graduating class, but I do regret the wasted energy that results from its lack of direction. Whose responsibility is it then to give it direction? Who is to sight the gun? Who is to lay it upon the target? Some such directing hand is necessary if we are not to be content with mere intellectual fireworks.

The College's Responsibility

It is of course a question as to how far the college is expected to go in fitting men to take their places in a particular line of industry. In the ordinary four-year college course it is fair to assume that the college can do little more than lay the foundation for subsequent intensive training and development for a particular work. I am very definitely opposed to the shaping of educational processes toward training for a specialized type of work before there has been laid a foundation of general knowledge and comprehension. The specialization should come after a certain degree of intellectual maturity has been reached. I do feel, however, that at the same time the mind is being molded and stored with knowledge, an effort should be made to determine the talents and characteristics that must be the controlling factor in the student's later life, and an opportunity given for the development of those qualities that will ultimately express the real character of the individual.

Our college tests and examinations are primarily directed toward the determination of mental attainments as measured by the extent of acquired knowledge. I am making a plea for the development of tests of a different character calculated to determine the student's potentiality rather than his static state. These tests would be in the nature of or the basis of a psychoanalysis of the student's character through observation of his manner, personality, physiognomy, heredity, environment and college career. These should be matters of constant observation and record, with particular reference to progress and development. These observations and records should be the constant study of a skilled psychologist or psychoanalyst who would take occasion to periodically counsel with the student as to his predominant characteristics and talents assisting and directing him to their higher development.

The Engineer and the Executive

Two distinct types are constantly being recognized in industry, namely, the engineering type and the executive type.

The engineering type of man works for the solution of a single technical or engineering problem and is concerned with the determination of the solution rather than the application of that solution to practical activities. The true type has the capacity to concentrate continuously on a single problem until the solution has been reached. He is interested in the determination of cause and effect and of the laws that govern phenomena. He is disposed to be logical, analytical, studious, synthetical and to have an investigating turn of mind. The predominating characteristic that distinguishes him from the executive is his ability to concentrate on one problem to the exclusion of others for a protracted period, to become absorbed in that problem and to free his mind of the cares of other problems. He does not submit readily to the routine performance of a given quality of work. He deals with laws and abstract facts. He works from textbooks and original sources of information. Such men are Edison, Steinmetz, the Wright brothers, Curtis, Bell, Pupin, Fessenden, Browning. These men are the extreme of the engineering type, they have enormous imagination, initiative, constructive powers.

The executive type takes the conclusions of the engineer and the laws developed by the engineer and applies them to the multitude of practical problems that come before him. His chief characteristic is that he works with a multitude of constantly changing problems at one time. He concentrates on one problem after another in rapid succession. In many instances he has not the time to obtain all of the facts and he must arrive at a conclusion or make a decision based upon partial knowledge. He must rapidly assimilate available facts and fill in what is lacking from the ripeness of his own experience, frequently calling upon his powers of judgment, and even intuition. He is a man of action, boldness, ingenuity, force, determination, aggressiveness, courage, decision; he is possessed with the desire to get things done, impatient of delay. He works from a handbook, a newspaper or nothing at all. Such men are Schwab, Goethals, Pershing, Farrell, Hindenburg, Hoover.

If we have accomplished nothing more than to assist the boy to determine whether he is a potential engineer

or an executive, it seems to me that we have gone far.

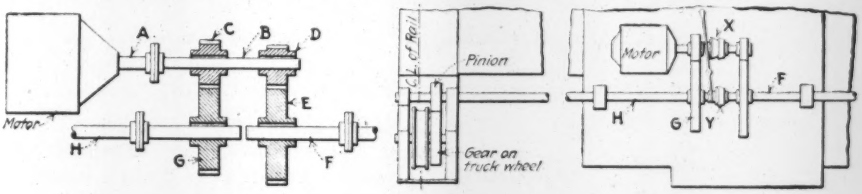
The question of whether a man has been trained in mechanical engineering or electrical engineering is not half so important as whether he is a real engineer or a real executive. I am sure that we are all acquainted with hundreds of young men who have made their success in some other branch of engineering endeavor than that in which they received technical training, and I feel quite safe in saying that the qualities of character determine a man's success rather than the particular kind or extent of technical knowledge that he has received in college.

Perhaps at the same time that the suggestion is made for the amplification of college training so as to include the psychoanalytical treatment of the student, it would not be out of place to suggest that industry take up a similar work on its own account and for its own purposes, with a view to confirming or supplementing the determinations made in the course of college life. It seems obvious that there is a community of interest as between the student, the pedagogue and the industrialist, and that all are seeking the same end, namely, the development to the full capacity of the individual for accomplishment.

We seek only to avoid the wasted energies, the wasted years and the wasted lives; the discredit to educational institutions and the loss to industrial and national life. The limitation upon industrial accomplishment today is men and the industrialist is call'ng for your assistance in minimizing this limitation. We require men rather than students and intellectualists. Will you give thought to the direction of the human forces which you generate?

Traveling Crane Has Radial Path

A 10-TON electric overhead traveling crane which operates on a circular track but has all its wheels of the same diameter is a special feature of the new roundhouse of the Pennsylvania Railroad System at Columbus, Ohio. In some previous roundhouse cranes



GEARING GIVES RADIAL MOTION TO TRAVELING CRANE

circular travel has been provided for by using truck wheels of larger diameters on the outer end of the crane or by using a larger driving pinion on the outer end of the driving shaft.

In the new design, the usual longitudinal shaft extending the full length of the crane girder or bridge is replaced by two shafts, each half the length of the crane and separately geared but driven by one motor. This arrangement is shown by the accompanying drawings. The motor shaft, *A*, is coupled to a short shaft, *B*, on which are keyed two pinions of different diameters, *C* and *D*. The smaller pinion, *D*, engages a spur or gear wheel, *E*, on a shaft, *F*, extending to the inner end of the crane. On the farther end of the shaft is a pinion engaging a gear on one of the truck wheels. The larger pinion, *C*, on the shaft, *B*, engages a gear wheel, *G*, on a shaft, *H*, which extends to the outer end of the crane and is geared to one of the truck wheels at that end.

The two driving pinions and their gear wheels are so proportioned as to give the required peripheral speeds for the inner and outer ends of the crane. In the Columbus roundhouse, the crane has a span of 74 ft. 4½ in. c. to c. of rails on concentric runways having radii of 137 ft. 1½ in. and 211 ft. 5¾ in.

Another function of the variable gears is to correct the tendency of traveling cranes to get out of square with their tracks, this tendency existing whether the runway is straight or curved. Such an inaccurate position may be due to unequal wear of the wheels, to the trucks not being exactly square to the girder, or to the crane being operated at high speed with a heavy load near one end.

To permit squaring or adjusting the crane bridge, the short shaft, *B*, is made in two parts connected by a clutch, *X*. A similar clutch, *Y*, provides for connecting the ends of the two longitudinal driving shafts. For a crane operating on a curved runway, this latter clutch would normally be inoperative, but for a crane on a straight runway it would be normally in action, forming in effect a single driving shaft. By the use of the clutches either end of the crane bridge may be moved independently to bring the crane square with or radial to its runways.

Simplicity of design and interchangeability of gears are among the advantages claimed for this system, which is the invention of R. W. Valls, vice-president and consulting engineer of the Champion Engineering Co., Kenton, Ohio.

Two-Story Bunk Houses Economical On Steep Sidehills

IN CONSTRUCTION camps maintained in high altitudes, the Southern California Edison Co. has adopted two-story bunk houses as standard. The reasons are that (1) foundation and roof costs are practically halved by thus doubling the floor area, and (2) heating can be done more easily and economically in the larger houses. Because of the considerable amount of dimension lumber required, foundation costs become an important factor where the camp has to be located on a steep sidehill. In the high altitudes the roofs are comparatively costly due to the necessity for taking care of snow loads. With the smaller area required, a two-story bunk-house camp can at times be located where there would not be room for a more extended arrangement. The house of standard design accommodates 16 men and conforms to all the requirements imposed by the California Immigration and Housing Commission.

One disadvantage of the two-story bunk house lies in the fact that the floor of the second story must be made tight, a condition not always easily obtained with the green lumber commonly used in building camps.

Exports for 1921 Above Pre-War Average

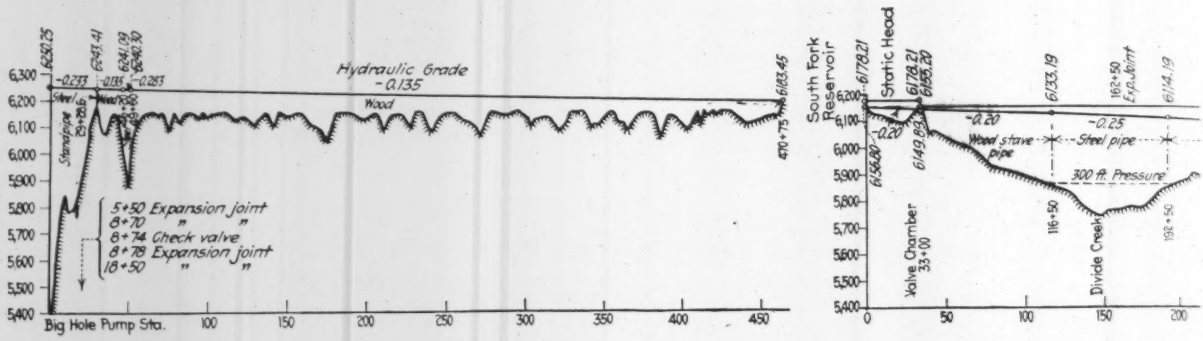
Although the amount and value of 1921 exports were below figures for the preceding two years they were in general far above pre-war averages. According to a study made by the foreign commerce department of the Chamber of Commerce of the United States, out of twenty principal exports only five show a decline, as measured in value, during the January to September period over the same nine months of 1909-1913.

Design and Construction of Welded Steel and Wood-Stave Pipe Line for Butte Water Co.

Wood-Stave Pipe Up To 300 Ft. Head and Above That Lap-Welded Steel With Welded End Joints —Regulating Chambers on Wood Pipe Expansion Joints at Crucial Points On Steel Pipe

By Eugene Carroll
Vice-President and Manager Butte Water Co., Butte, Mont.

CONTINUOUS banded redwood stave pipe for heads under 300 ft. and lap-welded steel pipe, with welded circumferential joints, for heads from 300 to 841 ft. is used on the Big Hole pipe line No. 2 of the Butte Water Co., of Butte, Mont., built in 1920, and in successful continuous use since that time. A limited number of regulating chambers on the wood pipe and of expansion joints at crucial points on the steel pipe were features of the design. Many construction difficulties were met and overcome on account of the rough country over which the pipe was laid, labor troubles, and the short working season, the latter being due to the latitude and to the altitude of some 5,000 to 7,000 ft. This article will deal with the design and construction of the pipe line, which for the first 3,000 ft. is a force main under a maximum static head of 841 ft., and then a gravity line, the total length being nearly 26½ miles, the diameters 24 and 26 in., and the nominal capacity 8 m.g.d., like the first pipe line between the same two points.



PROFILE OF BIG HOLE PIPE LINE NO. 2, BUTTE WATER CO., CONSISTING OF 24- AND 26-IN. BANDED CONTINUOUS

This earlier conduit—Big Hole pipe line No. 1—was completed in 1900. It consists of 3,000 ft. of 26-in. force main then 43,300 ft. of 26-in. pipe to the South Fork reservoir, then 97,470 ft. of 24-in. pipe to the West Side distributing reservoir, a total of about 27 miles. Banded continuous stave redwood pipe was used for heads up to 250 ft. and riveted steel for higher heads. Of the 97,470 ft. of gravity main, 63,566 ft. were wood-stave pipe.

To make feasible the use of so much low-pressure pipe the writer designed regulating chambers to keep the pressure down to what was then considered as safe limits for the wood pipe. These chambers, of which there were four in the 97,440 ft. between the South Fork and West Side reservoirs, were placed near the hydraulic grade line. They consist of a balanced valve operated by a float in a chamber on the outlet side. Each chamber has an overflow which, if the valve fails to work, will prevent an excess of pressure on the pipe line below. The discharge of the pipe line between the two reservoirs is therefore regulated by one valve at the lower or Butte end of the conduit. A great reduction in the cost of the pipe line was effected by these regulation chambers, which, together with the wood-stave pipe line, have now been in successful use for 21 years.

The success of conduit No. 1 led to a duplication of its general design for No. 2. The relative costs of wood and steel pipe in 1920 made it desirable to use wood-stave pipe up to heads of 300 ft. in the new pipe line, as compared with 250 ft. in the old one. This permitted a change in the location of portions of the new line which saved 3,912 ft. in its length. In conduit No. 1, 74 per cent is wood-stave pipe, while 81½ per cent of No. 2 is of wood. For pressures higher than 300 ft. lap-welded steel pipe was adopted at a material saving in cost over either cast-iron or riveted steel pipe. For end joints, welding was adopted, as being considerably less expensive than any other.

The objection to the welded circumferential joint was the necessity of taking care of the expansion and contraction in this line, with no precedent to govern from the fact that there is no line in existence of as large a diameter as 24-in., carrying water in which welded joints are used. The welded joint has proved to be a success in smaller diameters, being largely used for gas and oil lines in various parts of the country. In these smaller pipes, the contraction and expansion is taken care of generally by the variation in the alignment of the pipe itself, the flexibility of the pipe and curvature being sufficient to take care of the ordinary contraction and expansion after laying.

The variation in the temperature of the water supplied to Butte does not exceed 20 deg. F. between the coldest and warmest water during the year, and we believe that after the pipe is laid in a trench, covered by a 2-ft. minimum backfill, and filled with water, the contraction and expansion is negligible. The cost of a welded joint is not as great as an ordinary lead joint, which could not be used with pressures of

more than 450 ft. without reinforcement. The cost of reinforced lead joints, flange joints, or other heavy pressure joints for steel pipe is excessive.

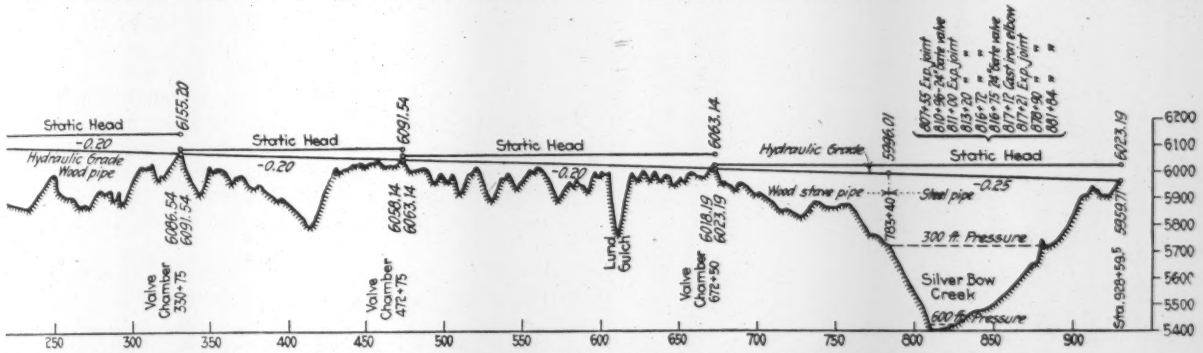
In designing the line, it was decided to make all connections between the steel pipe and castings, such as valves, cast elbows, and other fittings, with flange joints, protecting such connections with expansion joints on each side. Deeming it impossible in a pipe line of this character intelligently to place expansion joints at points necessary to take care of any strains caused during construction, it was decided to build the line without expansion joints and, after the line was placed in operation, to insert expansion joints at such points as the action of the pipe, after laying, would show necessary.

The new pipe line has a total length of 139,958 ft. or 24.6 miles, of which 25,736 ft. are of steel and 114,222 ft. of wood. In more detail, there are 3,525 ft. of 26-in. and 22,211 ft. 24-in. lap-welded steel pipe, manufactured by the National Tube Co., and 43,422 ft. of 26- and 70,800 ft. of 24-in. banded continuous stave redwood pipe, made and installed by the Redwood Manufacturers' Co. of San Francisco. The 26-in. pipe extends from the Big Hole pump station to the South Fork reservoir, from which point a 24-in. leads to the West Side distributing reservoir in the city of Butte.

Beginning at the Big Hole station, the steel pipe, under an operating head of 841 ft., extends up a slope of 32 deg. to El. 435 ft. above the station, where a 26-in. check valve is installed; thence in a level grade along the ridge, a distance of 800 ft.; thence up a steep mountain side to a point 2,900 ft. from the pump station, where the line is connected to a reinforced-concrete standpipe, 10 ft. inside diameter, and 67 ft. in height, the overflow being 841 ft. above the floor of the pump station. This standpipe relieves the line beyond this point from the strain due to water hammer, caused by the pulsations of the pumps, and provides a gravity flow from that point to the South Fork reservoir. From the standpipe to South Fork reservoir, 44,147 lin. ft. of wood pipe is used, except for 340 ft. of steel pipe across Charcoal Gulch, where the pressure exceeds 300 ft. The outlet at the South Fork reservoir is the highest point on the line, so that water is furnished to the Big Hole pump station for domestic and fire service when the pumps are not in operation. The South Fork reservoir is located on the South Fork of Divide Creek, a tributary of the Big Hole, and has a storage capacity of 13,500,000 gal., and also diverts the waters of the creek into the pipe line leading to Butte. During high water season for about sixty days each year, there is sufficient water at Divide Creek, thus permitting the closing down of the Big Hole station.

On the 24-in. portion of the conduit, at a point 3,300 ft. beyond the South Fork reservoir, the first regulating chamber is installed, which contains, in addition to the balanced valve and float, a 6-ft. Cippoletti weir. From this chamber the line extends northerly a distance of 29,700 lin.ft., crossing the continental divide, to the second float chamber. In this section of the line, wood pipe is used, except in crossing Divide Creek, where 7,600 ft. of steel pipe is laid. From this second valve chamber the line extends northerly, a distance of 14,300 ft., to the third regulating chamber, and consists of wood pipe. From the third regulating chamber the line extends northeasterly over a very rough country, a distance of 20,000 ft., to the fourth regulating chamber, and consists of wood pipe. From the fourth regulating chamber the pipe line continues in a northeasterly direction, with 11,100 ft. of wood and 14,580 ft. of steel pipe, to a weir chamber at the West Side reservoir. These regulating chambers are located on the hydraulic grade line for the full capacity of the pipe line, and are equipped as already described.

General Construction—The contracts for material



STAVE REDWOOD PIPE AND LAP-WELDED STEEL PIPE WITH WELDED CIRCUMFERENTIAL JOINTS

were let in the fall 1919 and consisted of a contract with the Redwood Manufacturers' Co. for the wood pipe under specifications prepared by the Butte Water Co. Under this contract the ditch was prepared and material delivered by the water company from points on the Oregon Short Line R.R., which parallels the pipe line, to convenient points along the ditch. The pipe company erected the pipe in the ditch and guaranteed it against defective material for one year after completion.

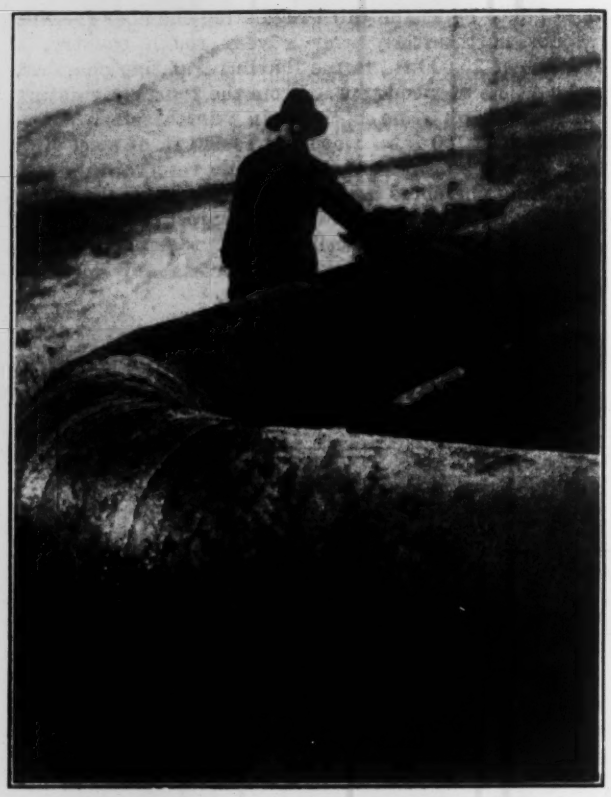
The contract for the steel pipe was awarded to the National Tube Co. and covered only the pipe and its delivery on cars at points along the Oregon Short Line. The thickness of the steel varied to conform to pressure, 22,388 lin.ft. of the 24-in. having a thickness of 0.33 in.; 2,903 ft., of 26-in., 0.362 in.; 360 ft., of 26-in., 0.4375 in.; and 443 ft., of 26-in., 0.5 in. The pipe came in varying lengths, averaging about 17.5 ft., with beveled ends for welded joints.

The contract for the valves and fittings, consisting of four 24-in. balance float valves, three 26-in. high-pressure hydraulic gate valves, six 26-in. low-pressure gate valves, nine 24-in. low-pressure gate valves, twenty-two 6-in. gate valves and forty-one 2-in. gate valves, was awarded to the Ludlow Valve Manufacturing Company.

Equipment for construction consisted of two Austin

dragline excavators, one Holt caterpillar with four Troy trailers, one Austin back-filler, two 5-ton Pierce-Arrow trucks, four 1½-ton Reo trucks, two air compressors with jack-hammer equipment, all operated by gasoline, and tents, camp equipment and tools, to take care of six hundred men.

Owing to the short working season in this climate, all construction equipment and considerable material were delivered during the winter of 1919-1920, and work was started early in April. On May 7, just as the work was well on its way, a strike was called which caused a delay of about thirty days. This and other



A 90-DEGREE BEND IN 24-IN. STEEL PIPE WELDED TOGETHER READY FOR LOWERING TO PLACE

hindrances caused by labor agitation seriously impeded the progress of the work, causing considerable additional expense by delaying all of the backfilling and considerable of the concrete work until during freezing weather. The line was finally completed and placed in operation on Dec. 7, 1920, and, except for occasional interruptions caused from repairing defective work, has been in continuous successful operation ever since.

Wood Pipe—The 26-in. wood pipe used in this line is constructed of sixteen 1⅝ x 6-in. redwood staves with sides dressed to conform to the inside and outside radii of the pipe, and edges dressed to true radial planes, with tongued and grooved edges. The end of two adjoining staves are in no case closer than 24 in. The 24-in. pipe is constructed of twenty-three 1⅝ x 4-in. Redwood staves dressed and laid in the same manner as the 26-in. pipe. The material was perfectly clear lumber. It was inspected at the railroad and the inspection continued with vigor through the whole construction. Building crews of the contractor consisted of one foreman and five laborers, and their average day's work of 8 hr. was 250 lin.ft. of pipe. Steel bands of ½-in. diameter were used on both sizes of wood pipe. The number of bands placed on the 24-in. pipe at various pressures was at the rate of 271 per 100 ft. of pipe under 100 ft. head, and on the 26-in., 286 bands, likewise. A factor of safety of five was used in banding the pipe, but the spacing was not permitted to exceed 8 in. on the lightest pressures. A total of 1,800,000 ft. b. m. of redwood staves and 412,720 ½-in. steel bands were used.

Steel Pipe—In laying the steel pipe, several hundred feet were welded together on skids extending across the excavated ditch, and then lowered into place from one end, the other end being left on skids above the ditch, thus permitting additional pipe to be welded and lowered into place, avoiding the necessity of trench welding and "bell holes" excavation. On the 32 per cent grade, after leaving the Big Hole pump station, two lengths were welded together at the foot of the grade, and hoisted in place over the ditch, using a hoist equipped with wire cable. These double lengths were then welded together on skids over the trench, and lowered, beginning at the foot of the slope. Where the ground permitted, seven lengths of pipe were welded together alongside of the ditch, then rolled on skids over the ditch, welded, then lowered from one end, care being taken not to cause any undue strain on the welded joints. An inspector went inside of the pipe after welding was completed, painting the welds with preservative paints and chipping off any excessive metal, thus making the inside practically smooth when completed.

The ditch was excavated 4 ft. wide and to a minimum depth of 4 ft., which gave ample room for handling the pipe. As the pipe line through the most of the distance passes through mountainous country, the excavation was both expensive and difficult, over 40 per cent being through solid rock. From the fact that the location of the line is governed by the hydraulic grade, we had no choice as to the location.

As the pipe was lowered into the ditch it was backfilled immediately to a depth of 4 in. above the top of the pipe, carefully tamped, to protect it from the weather and to prevent excessive contraction and expansion after being put in place. As soon as possible, water was turned in to each completed section, enabling us to locate defective work.

Expansion Joints—In the original construction, two expansion joints were placed in the 26-in. and six in the 24-in. pipe at various points along the line. These expansion joints were installed originally to protect the valves and other castings. Later it was found necessary to install six expansion joints at points where strains had developed in the pipe line. This number was much less than anticipated. The last of these joints was inserted in January, 1921. The continuous operation of the pipe line without trouble since that time indicates that all construction strains have been cared for.

In the finished pipe line the longest section of pipe between expansion joints and horizontal angles is 4,600 ft.; the longest section of pipe between expansion joints, but with horizontal bends, is 6,170 feet.

That so few expansion joints were necessary is attributed (1) to the very small variation in the tem-

STEEL PIPE WELDED TO FORM A REVERSE CURVE READY TO LOWER INTO TRENCH

perature of the water and (2) to the uneven alignment of the pipe, caused by the rough country through which it is built taking care of the contraction and expansion and by settling of the pipe after construction. Most of the defective joints were cracks on top of the pipe, indicating that the majority of them were caused by settlement of the pipe after laying. Where a joint broke and the pipe pulled apart, indicating a strain, no further trouble in that part of the line was experienced after the installation of an expansion joint.

Connections to Valves and Special Fittings under the original design were made by welding a steel flange to the pipe. This proved to be extremely difficult work, and we failed to weld properly any flanges to pipe without warping the flanges, which necessitated the refacing of all flanges. To overcome this difficulty, we discarded all cast-iron fittings, with the exception of valves, and made the bends from steel pipe. These bends were cut according to patterns furnished the welders, and the result was a neat and uniform bend at much less cost than a cast-iron fitting.

Welding End Joints—The oxy-acetylene process was used to weld the circumferential joints. Portable Oxweld low-pressure generators and union carbide were used to supply the acetylene gas, each generator being capable of furnishing 50 cu. ft. of gas per hour, which gave an ample supply at all times for two blow pipes of suitable size. Oxygen was furnished by the Linde Air Products Co., in 100-lb. cylinders. A contract was let to a local firm for the welding but, owing to an incompetent foreman, it became necessary to cancel this contract, after which we awarded the contract to F. E. Woodbridge, who had had considerable experience in welding pipe of smaller diameter for oil lines. After awarding him the contract, we had very little further trouble, except from the fact that it was very difficult to secure competent welders.

Under the first contract for welding, notwithstanding careful inspection, a great deal of defective work developed. In the first pipe laid under the original contract, 10 per cent. of the joints were found defective and had to be repaired. This was reduced on the later work to 1.7 per cent. Of the 1,568 welds made on both the 24- and 26-in. pipe, 58 joints were defective, amounting to 3.7 per cent. of the joints made, but most of these were small cracks, usually on top of the pipe, and were repaired at very small cost. Considering the fact that this kind of work was new to all of us, and that a large part of the work was done through a very rough country, which necessitated more or less rough handling of the pipe, the percentage of defective work was exceedingly small.

In making the welded joints, we found that the best results were obtained by thoroughly heating the pipe for 6-in. on each side of the joint. Troubles from contraction and expansion were very small when this rule was adhered to. Most of our trouble, aside from the defective work, is attributed to the settling of the pipe after being placed in the ditch and filled with water, causing small cracks in the joints, which were easily repaired. In the welding, great care was taken to fill the joints entirely full of metal, without permitting the molten metal to run inside the pipe. The welding was started at the bottom of the groove, and carefully worked out to the outside diameter of the pipe, where a good ridge was made above the pipe. In welding, the ends of the pipe were held together by collars, until the pipe was tacked at four places with tacks about 4-in. long. The collar was then removed. The best results were obtained by using two welders on opposite sides of the pipe, working towards each other.

When the grade of the pipe line was uniform the pipe was placed on skids alongside the ditch and welded together in lengths of 120 ft. This enabled all welding of each section to be made from above, the pipe being turned as required. These sections of pipe were then placed on skids over the trench and welded together. It was found that sections of a maximum length of 120 ft. of pipe was all that could readily be placed in a position to be welded together. In handling the pipe in this manner only a small percentage of work was overhead welding.

STEEL PIPE TACKED TOGETHER READY FOR WELDING

Welding rods of $\frac{5}{32}$-in. diameter were used at the beginning of the work, but were soon discarded for $\frac{1}{4}$ and $\frac{5}{16}$-in. rods. On the heavy pipe and flanges, with a skillful welder, $\frac{3}{8}$-in. rods were used. Number 12 and 15 Oxweld tips were used almost exclusively on the work.

All joints were painted inside and out with preservative paint after completion and inspection.

Costs—After over one year's operation of Big Hole Pipe Line No. 2, we feel justified in asserting that the use of steel pipe of large diameter with welded joints has proved a success. The reasons for adopting this construction have been fully justified in the results as to cost. A table of costs in this line would be of very little value to the profession because conditions were

abnormal, both material and labor being at the peak, with efficiency very low, besides which labor in the vicinity of Butte was extremely scarce, and labor troubles added materially to the cost. Finding it impossible to come to any kind of a satisfactory agreement with the labor unions during the whole construction, the company was on the unfair list, being unduly annoyed by boycotts and other difficulties arising from the troubles with union labor. While union wages were paid in all the different departments and no attempt was made by the management to oppose union labor, the construction was handled under the "American plan," which caused continual friction between the company and the union heads, who endeavored to force closed shop conditions.

In the welding, particularly in the early part of the work, competent foremen and operators seemed impossible to secure, causing considerable extra expense, not only in construction but also in defective work. Welders were paid $9 a day of 8 hr., with time and a half for overtime, but even so, it was very difficult to procure competent men.

Common labor was paid $5.50 per day of 8 hr.; skilled labor in proportion. All kinds of labor-saving machines were used in the construction. The cost of the delivery of material, on account of the mountainous character of the country, was extremely high in many places, requiring handling three times—(1) in a truck, (2) thence by tractor with trailers; and (3) by hand—before delivering alongside of the ditch. The total construction cost was 45 per cent. greater than the estimate made in 1917, which was based on current prices at that time. Labor costs exceeded the estimate from 8¼ per cent for compressor men to 100 per cent. for cooks and flunkies.

Material costs exceeded the estimate—principally on wood pipe—from 18 per cent on structural steel to 62 per cent on lumber. The labor cost for 241 welds on 26-in. steel pipe was $28 each, and on the 1,327 welds on 24-in. pipe, $16.13 each; the average cost of the 1,548 welds—9,973 ft. of welding—was $51.47 per joint. The estimated cost of an ordinary lead Matheson joint was $50.55, showing that the welded joint cost 1.8 per cent more than the Matheson joint, which joint could not have been used without reinforcement on more than 31 per cent of the joints. The final cost of joints per lineal foot of steel pipe, including elbows, etc., was $3.18 per foot, divided as follows: Unloading and transportation $0.429; erection, $0.941; welding labor, $1.059; welding supplies, $0.751. The average length of pipe between joints was 16.83 feet.

All location and construction work was under the supervision of James H. Kyd, chief engineer of the Butte Water Company.

Panama Canal Traffic in 1921

Traffic through the Panama Canal during 1921 averaged 232 vessels a month, only 2.4 less than in 1920. In net tonnage and tolls 1921 exceeded 1920, 11,435,811 tons passing, as compared with 10,378,265 tons the previous year. The tolls, according to the *Panama Canal Record*, aggregated $10,325,718.02 in 1921, and $10,295,362.21 in 1920. Cargo carried through the Canal in 1921 was 527,771 tons less than the previous year.

Tests on Absorptive Qualities of Concrete Blocks

Effect of Varying Aggregate, Cement and Water Content, Curing Conditions and Density Observed on Small Test Blocks

By Stanton Walker

Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill.

Abstract of paper presented at meeting of Minnesota Section of the American Concrete Pipe Association

ABSORPTION holds a prominent place in all specifications for quality of concrete products. Notwithstanding the importance attached to this property, little information has been published concerning it. It is felt that it will be of interest, particularly to the manufacturers of concrete products, to present data showing the relation of absorption to various factors which govern the strength of concrete. Much information on this subject has been obtained from researches carried out at the Structural Materials Research Laboratory, Lewis Institute, Chicago, under the direction of Prof. Duff A. Abrams. This laboratory is conducted through the co-operation of the Lewis Institute and the Portland Cement Association.

This paper is based on data from an investigation of the strength and wearing qualities of concrete for floor surfaces (Series 134). Strength tests were made on 6 x 12-in. cylinders and wear tests on 8 x 8 x 5-in. blocks. The wear blocks were used later for the absorption tests. Mixtures ranging from 1:4 to 1:1 were studied. The size and grading of the aggregate was varied from sand finer than a 28-mesh sieve to concrete aggregates graded up to 1½ in. The consistency of the concrete as affected by the water content was varied from dry to sloppy. The effect of time of storage of concrete in a moist condition was studied.

The specimens used for the absorption tests were 8 x 8 x 5-in. concrete blocks. The concrete for each specimen was proportioned separately and mixed by hand in a shallow metal pan with a bricklayer's trowel. A cubic foot of cement was assumed to weigh 94 lb. Mixtures are referred to as one volume of cement to a given number of volumes of aggregate mixed as used. In general the aggregate was sand and pebbles from Elgin, Ill. The cement was a mixture of equal parts of five brands of portland cement purchased in Chicago. Water from Lake Michigan was used for mixing. The concrete was puddled into the forms by means of a ⅝-in. round rod pointed at the lower end. The specimens were removed from the forms 16 to 20 hr. after molding and stored in damp sand for 14 days and the remainder of time in dry air, except in instances where the effect of time of storage was investigated. At the age of 3 months the blocks were subjected to the wear test in the Talbot-Jones rattler; after which they were again stored in a dry room for about 9 months.

The blocks in a dry room condition were immersed in water at room temperature and the absorption determined at periods of 1, 2, 3, and 7 days. The gain in weight expressed as a percentage of the dry weight was taken as the absorption. The absorption at 48 hours is used in most of these studies, due to the fact that this period is used as the basis of many specifications for the absorption of concrete products.

Due to the large number of specimens it was not practical to dry them to constant weight. Several blocks which were dried to constant weight at a temperature of 110 deg. C. showed a loss in weight of from 2.5 to 3 per cent. This method of handling is partly responsible for the somewhat low absorption found. It is believed however that the values determined under these conditions give reliable data on the relative effect of different factors.

The 6 by 12-in. cylinders used for the compression tests of concrete were molded at the same time as the blocks. The conditions of storage and age at test was the same as for the corresponding wear blocks.

Size and Grading of Aggregate—The fineness modulus is used as a measure of the size and grading. Fig. 1 shows

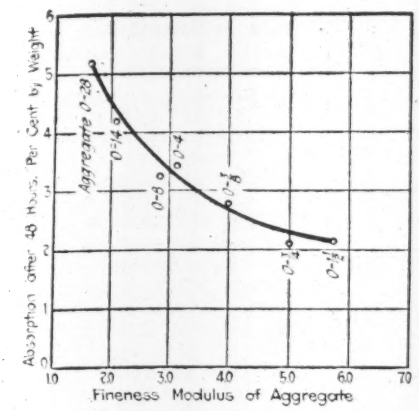


FIG. 1. EFFECT OF SIZE AND GRADING OF AGGREGATE ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. In general, value is the average of 12 tests, two from each of 6 mixtures, as follows: 1:4, 1:3, 1:2½, 1:2, 1:1½, 1:1.

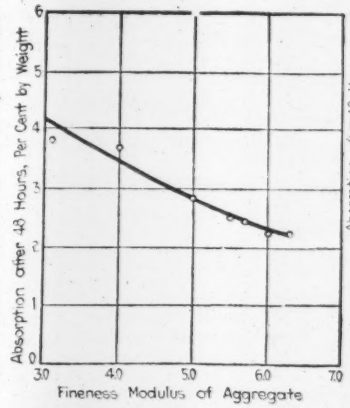


FIG. 2. EFFECT OF GRADING OF AGGREGATE ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill., and crushed limestone from Chicago, graded 0-1½ in. limestone from Chicago, graded 0-1½-in. Specimens stored in damp sand 14 days, and in dry room for about 1 year. In general each value is the average of 16 tests, two from each of 4 mixtures as follows: 1:4, 1:3, 1:2½, 1:2, and 2 aggregates.

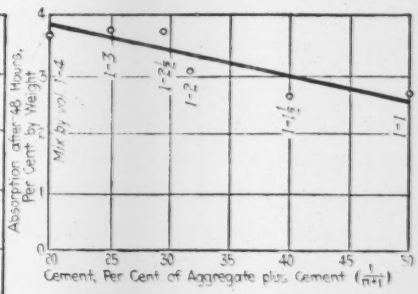


FIG. 3. EFFECT OF QUANTITY OF CEMENT ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water at room temperature for 48 hours. In general each value is the average of 12 tests, two from each of 6 sizes of aggregates. 0:28, 0:1½, 0:8, 0:4, 0:⅜, 0:¼, 0:½.

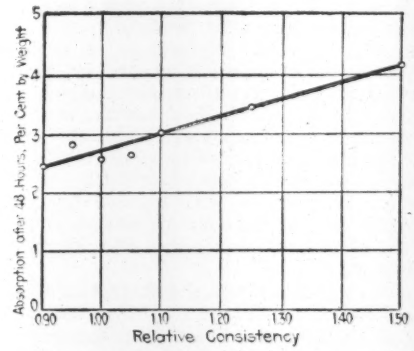


FIG. 4. EFFECT OF QUANTITY OF WATER ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Aggregate; sand and pebbles from Elgin, Ill., graded 0-⅜ in. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water of room temperature for 48 hours. In general each value is the average of 6 tests, two from each of 3 mixtures as follows: 1:3, 1:2½, 1:2.

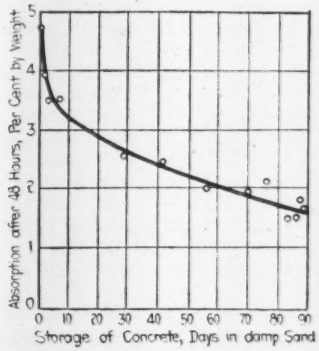


FIG. 5. EFFECT OF CURING ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill., graded 0-⅜ in. Specimens stored in damp sand for periods noted, remainder in air. Tested at age of about 1 year. Immersed in water of room temperature for 48 hours. In general each value is the average of 6 tests, two each from 3 mixtures as follows: 1:3, 1:2½, 1:2.

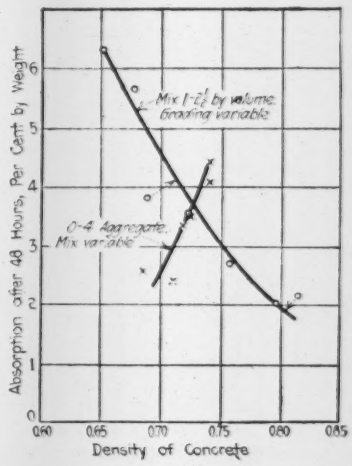

Absorption after 48 Hours, Per Cent by Weight
Mix 1-2½ by volume, Grading variable
0-4 Aggregate, Mix variable
Density of Concrete

FIG. 7. RELATION BETWEEN DENSITY AND ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water of room temperature for 48 hours. In general each value is the average of 2 tests.

data for seven sizes of aggregate. The values are the average of tests made on six different mixtures ranging from 1.4 to 1.1. Each aggregate was well graded within the range of sizes indicated. The sieve analyses are shown in the accompanying table. The absorption decreased from 5.2 per cent for concrete made from 0-28 aggregate to 2.2 per cent for the 0-1½ in. aggregate. Fig. 2 shows the effect of variations in grading of the aggregate caused by wide variations in the sand content. The aggregate having a fineness modulus of 3.10 is sand only; that having a fineness modulus of 6.25 is made up of 20 per cent sand and 80 per cent No. 4-1½ in. pebbles or crushed limestone. The values are the average of tests made on the two aggregates and on four mixtures. It will be noted that the absorption decreased as the aggregate became coarser (less sand was used) confirming the indications of the data in Fig. 1. Comparison of Fig. 1 and 2 with the upper left portion of Fig. 6 shows that the strength of concrete is affected by the grading of the aggregate in an opposite manner from the absorption. These diagrams indicate an intimate relation between the absorption and strength of concrete.

Quantity of Cement — The effect of variation in the quantity of cement on the absorption is shown in Fig. 3 for mixtures ranging from 1.4 to 1.1. The values are averages from six gradings of aggregate. The percentage absorption decreased about 0.04 for each additional 1 per cent of cement. That is, it changed from 4.8 for 20 per cent of cement to 4.4 for 30 per cent of cement. Reference to Fig. 6 shows that the strength increased with the quantity of cement.

Quantity of Mixing Water.—The absorption of concrete increased with the quantity of mixing water so long as the concrete was plastic The strength was decreased by the addition of water, (See Figs. 4 and 6.) The quantity of mixing water is expressed as "relative consistency." A relative consistency of 1.00 represents concrete of such a plasticity that a freshly molded 6 x 12-in. concrete cylinder will slump ½ to 1 in. upon the removal of the metal form by a steady upward pull. Concrete of a relative consistency

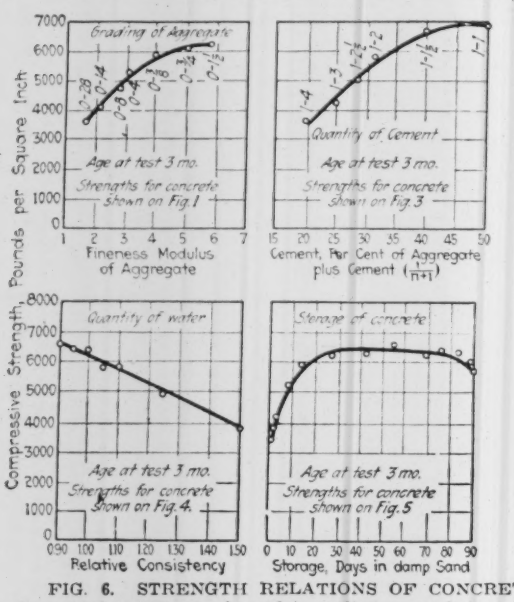

Grading of Aggregate
Age at test 3 mo.
Strengths for concrete shown on Fig. 1
Fineness Modulus of Aggregate
Quantity of Cement
Age at test 3 mo.
Strengths for concrete shown on Fig. 3
Cement, Per Cent of Aggregate plus Cement
Quantity of water
Age at test 3 mo.
Strengths for concrete shown on Fig. 4.
Relative Consistency
Storage of concrete
Age at test 3 mo.
Strengths for concrete shown on Fig. 5
Storage, Days in damp Sand
Compressive Strength, Pounds per Square Inch

FIG. 6. STRENGTH RELATIONS OF CONCRETE

Compression tests on 6 x 12-in. cylinders made parallel with absorption blocks referred to in Figs. 1, 3, 4 and 5.

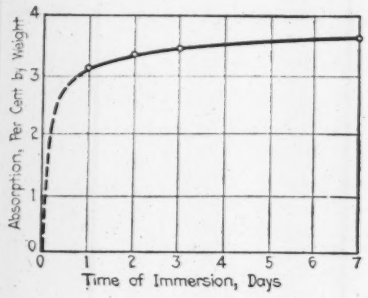


FIG. 8. EFFECT OF TIME OF IMMERSION ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water of room temperature. In general each value is the average of 84 tests, two each from 7 sizes of aggregate and 6 mixtures.

of 1.10 contains 10 per cent more water than that of a relative consistency of 1.00. It should be remembered that these tests were made on hand-molded concrete blocks. All of the concrete was sufficiently plastic to be puddled into place with a rod. The 0.90 relative consistency represents about the driest concrete that can be handled in this way. It contains about 20 to 25 per cent more water than the average machine-made block. This does not mean, however, that, other conditions being equal the machine-made block would have less absorption than that molded by hand, in proportion to its lower water content. The minimum absorption will be found for some quantity of water which varies with the method of molding mixture used, characteristics, of aggregate, etc. The tendency is to make the machine-molded products with too little rather than too much water.

Curing Concrete.—The importance of curing concrete in a moist condition is illustrated in Fig. 5. Tests made for periods of storage in damp sand up to 3 months showed less absorption for the longer periods of storage. The absorption for concrete stored in damp sand 3 weeks was less than half of the value obtained for the same concrete stored in dry air from the time it was removed from the forms. Fig. 6 shows the beneficial effect of storage in a moist condition on the strength of concrete.

TABLE SHOWING SIEVE ANALYSES OF AGGREGATES

Sieves were square mesh, woven wire from "Tyler Standard Screen Scale," manufactured by the W. S. Tyler Company, Cleveland, Ohio.

Aggregate; sand (Lot No. 4653) and pebbles, (Lot No. 4768) from Elgin, Ill., and crushed limestone (Lot No. 3958) from Chicago, Ill. The sieve analyses may be identified with the aggregates represented on the diagrams by the size and fineness modulus.

Size of Aggregate	Amount Coarser than Each Sieve Per Cent by Weight									Fineness Modulus	Weight Lb. per Cu. Ft.
	100	48	28	14	8	4	¾	1½	1¼		
0–28	94	71	0	..	..	..	..	..	..	1.65	105
0–14	96	80	34	0	..	..	..	..	..	2.10	108
0–8	98	90	60	32	0	..	..	..	..	2.80	111
0–4	99	90	62	39	20	0	..	..	..	3.10	112
0–¾	99	93	74	58	45	31	0	..	..	4.00	117
0–½	99	96	82	71	63	53	36	0	..	5.00	127
0–1¼	99	92	71	53	38	23	18	6	0	4.00	124
0–1½	99	95	81	69	59	49	36	12	0	5.00	128
0–1½	99	96	85	77	69	62	47	15	0	5.50	130
0–1½	99	97	88	80	74	68	52	17	0	5.75	128
0–1½	99	97	90	84	79	74	58	19	0	6.00	127
0–1½	99	98	93	88	85	81	61	20	0	6.25	123

Density of Concrete.—There is no *general* relation between the density of the concrete and the absorption. Fig. 7 shows two features of this variation. For a constant quantity of cement and for different sizes of aggregate, the absorption was less for the higher densities. Although not shown on this figure, this relation was also found to hold for variations in consistency. Varying the cement content with other factors constant, showed an *increase* in absorption as the density increased—an exactly opposite relation from that found by varying the grading of the aggregate or the quantity of mixing water.

Time of Immersion of Concrete.—Fig. 8 shows the absorption after immersion for periods of 1, 2, 3, and 7 days. It will be noted that the increase in absorption is very slight after 48 hours. A study of all of the data showed that the rate of increase was approximately the same for all conditions. The value for 48 hours, which was used in the discussion of the tests, showed no essential difference in relationship with the different variables from the values for the other periods.

Relation between Strength and Absorption Concrete.—All tests in this investigation show that the absorption varied inversely with the strength. In general concrete having a low absorption had a high strength. So far as these data show, this relationship cannot be represented by a single function, that is, concretes of different composition having the same strength do not necessarily have the same absorption; but all factors which tended to *increase* the strength, *decreased* the absorption, and vice versa. The absorption was most affected by changes in grading of aggregate and was least affected by changes in cement content.

1. The absorption of concrete was reduced by using coarser aggregates, so long as the concrete was plastic.

2. The absorption of concrete was reduced by increasing the quantity of cement.

3. *For the conditions of these tests* the absorption of concrete was increased as more mixing water was used.

4. The storage of concrete in a moist place immediately after molding decreased the absorption. The longer the concrete was kept moist the lower the absorption.

5. The relation between the density of concrete and the absorption depended on conditions. For a constant quantity of cement the absorption became *less* as the density of the concrete increased. For a variable quantity of cement, with other factors constant the absorption became less as the density *decreased*.

6. There was an intimate relation between the strength and absorption of concrete; in general concrete of a high strength gave a low absorption.

Is Engineering a Healthful Occupation?

Engineering is a healthful occupation by statistics; at least so far as tuberculosis is concerned. In a table of 53 occcupations compiled by the Chicago Tuberculosis Institute engineers and surveyors were forty third and had a mortality rate of 145 per 100,000 due to the white plague. Marble and stone cutters came first with a rate of 531. Architects are worse off than the engineers, being in thirty-eighth place with a rate of 187, while teachers, lawyers, soldiers and sailors, steam railroad employees, miners, quarrymen, farmers and bankers, brokers and officials of companies are all better off than the engineer in the order named. The bankers, brokers and company heads are in a distinct class at the end of the list, with a rate of 92 against 112 for the farmers the next highest.

Port Authority Presents Arguments Against Narrows Tunnel

Bi-State Body Contends that Its Scheme Will Cost Less and Will Operate More Efficiently Than That of City

UNDER date of Jan. 23, 1922, the Port of New York Authority issued a statement comparing its comprehensive plan with the Narrows tunnel plan proposed by the City of New York. From that report the following extracts are taken, to present the arguments of the bi-state body on approximately the same issues as were discussed by the city's representative, Col. W. J. Wilgus, in the abstract of his report in last week's issue, p. 248.

The variation in costs noted in the footnote in the table is apparently due to the difference in estimates of the southerly and northerly routes proposed by the city. It should also be noted that the unit costs given in that table for the city's plan are those figured by the Port Authority and are in excess of those figured by the city for the same route. The basis of unit cost figuring, however, is so different by the two bodies as to make comparison difficult.

The table contains a comparison, based on engineering analysis, of the important features of the Port Authority's plan with the city's proposal. Reference to this table will show that the middle belt line of the Port Authority's plan from its northernmost terminal to Bay Ridge, Brooklyn, is 17.1 miles long while the city's belt line from its northernmost terminal to Bay Ridge, Brooklyn, is 67.5 miles, the excess length of the city's line being 50.5 miles.

The Port Authority's tunnel is 24,290 ft., while the [southerly] Narrows tunnel proposed by the city is 22,750 ft. or 1,540 ft. shorter. In this connection it must be remembered that the ruling grade of the Port Authority's tunnel is 1.6 per cent while the ruling grade of the tunnel under the Narrows is 2 per cent. If the grades of the city's tunnel were the same as the grades of the Port Authority's tunnel, the length of the city's tunnel would be increased appreciably.

Comparative Costs

The estimated cost of constructing the 17.1 miles of belt line including the tunnel under Upper New York Bay as proposed by the Port Authority is $65,000,000. The City Engineers estimate the cost of constructing the belt line it proposes together with tunnel under the Narrows at $93,000,000. It will be seen that the excess cost of the city's line is twenty-eight million dollars.

As the length of the city's belt line is so much greater than the middle belt line proposed by the Port Authority, it is easy to comprehend why the table shows that to move via the city's line the same amount of tonnage and the same number of cars between the classification yards in New Jersey and their destination or point of origin in Brooklyn, Queens or the Bronx, would necessitate 1,620,000 train miles as against 910,000 train miles under the Port Authority Plan and 973,000,000 net ton miles under the City's Plan as against 477,000,000 net ton miles required under the Port Authority plan.

The dissimilarity of physical characteristics of the two lines in grade and length, of course explains the excess first cost and the excess amount of effort measured in operating costs, required to perform a given service under the city's plan.

Naturally these disadvantages are reflected in the cost per car which would amount to $11.34 under the Port Authority's plan as against $15.17 under the city's proposal, the excess under the latter scheme being $3.83 per car. On a traffic movement of 1,340,000 cars annually, this excess cost would amount to more than $5,000,000 per annum, which if capitalized at 6 per cent amounts to $85,000,000.

Discussion in the report of the Board of Estimate and Apportionment fails to convince the practical railroad operator that its proposal is an operating feasibility. Let us assume that the freight destined to Brooklyn and Queens and for interchange with the Long Island and New Haven railroads would be broken out of trains arriving by the many railroads entering the port, as those trains reach a junction point with the outer belt line. But this assumption is not reasonable. There is nothing in the city's engineers' estimated cost of the proposed facility for construction classification yards at each of these junction points. Nor is there included in the estimated cost of operation any expense for *yarding*, that is, the breaking up of trains, classifying and switching cars and making up trains into switching units at these junction points.

The city's report is likewise silent *on the matter of delay that classification at junction points would occasion to the balance of the 50 or 60 million tons of freight moving into and out of the Port annually, besides that which the city engineers have assumed would move via its proposed belt line and tunnel.*

If, however, the traffic to and from the easterly side of the port is not to be broken out of trains and made up into switching units at the junction points, what then is the plan of operation? Transportation experts familiar with the character of the traffic handled through the Port of New York and its currents of flow, cannot even begin to take seriously the suggestion that it is practicable, to any extent, to make up solid trains at divisional yards of the several lines in the interior and move such trains directly to junctions with the proposed belt line, thence via that line to the proposed yard in the Borough of Richmond.

Trains now arriving at the port district contain freight for every section, that is, Manhattan, Newark, Greenville, Jersey City, Bayonne, Hoboken, Edgewater, Brooklyn, Queens, Bronx, Richmond, and as well for interchange with the New Haven, Long Island and New York Central railroads; also freight for export and coastwise shipment. This freight originates all along the line of each railroad from a distance of a thousand miles or more right up to the port district.

Without interminable delays it would be impossible so to classify this freight at divisional yards in the interior as to enable it to move in solid trains from those yards directly to the junction points with the belt line, thence to the proposed yard at Richmond.

Yard Needs

That this is true can be illustrated by taking the inbound business on one of the trunk lines as an example. It approaches the Port District through six yards. Business from the west through one yard; business from a large city through its yard; business from the south through another yard; business from a branch line through its yard; business from western New Jersey through another yard and business from southern New Jersey through still another yard. There is not enough traffic passing through any one of these yards daily, to make up a solid train for any particular section of the port district, except one which has enough business to make up a few solid trains daily.

To hold cars at the divisional yards in the interior until solid trains could be dispatched would in many instances cause several day's delay to the freight. It is plain to be seen that additional yards will be necessary at junction points with the proposed belt line. However, even though yards were provided at junction points, there would be a considerable volume of business which would have to be handled into the present classification yards and back again to the junction point, for example: all cars for transfer stations would have to be taken to the transfer platforms which are now located near the classification yard, and freight for Brooklyn, Queens or Long Island reloaded into other cars would have to be hauled back to the junction point of the belt line, thereby causing a direct loss of time and money. Such operation as this is impracticable, with reference to the eastbound movement; it is impossible when the westbound movement is considered.

Even with new classification yards on Staten Island at which westbound cars would be classified by railroads, it would be necessary for each railroad to take these cars to their present yards and transfer stations in order to make

up solid trains for such points as Chicago, Cleveland, Buffalo, etc. There would certainly be serious objection from shippers to the delay that would occur by any such movement. It is doubtful if freight shipped one day would move out the same day; at best it would be several hours later in leaving. Not only would there be this delay, but the additional expense of the back haul.

The proposed belt line in New Jersey is approximately fifteen miles west of the Hudson River and an average of twelve miles west of the present classification yards of the New Jersey railroads. It has been shown that the operation of such a line for the purposes intended, if otherwise practicable would necessitate yards at the junction of each railroad line with the belt line.

What justification can there be for advocating such a waste of capital? There exists today a classification yard on each railroad to serve the terminal district in New Jersey. These yards are outside of the congested area of terminal operation.

The congestion that has occurred in present classification yards in the past and that will undoubtedly occur in the future if measures of relief are not taken, comes about by reason of congestion along the New Jersey waterfront.

From Weehawken to Communipaw there are handled approximately two million cars annually between the two sides of the port. More than one and one-half million of these cars are bridged to and from the carfloat at the New Jersey waterfront yards. This is where the congestion occurs. The Port Authority's plan will relieve this congestion by diverting part of this traffic directly at the classification yard to its Middle belt line, by which it will move directly to Brooklyn, Queens and New England; the balance destined to Manhattan, will be diverted to the joint yards which it proposes for Manhattan freight, thus keeping out of the waterfront yards on the New Jersey side all of these cars.

COMPARISON OF SALIENT FEATURES OF THE PROPOSAL OF THE CITY OF NEW YORK WITH THE PORT AUTHORITY'S PLAN

Physical Characteristics:	P. A. Plan	City's Plan
Belt line, northernmost terminal to electric section	11.1 mi.	57.9 mi.
Electric section, including tunnel to Brooklyn	6.0 mi.	9.6 mi.
Total New Line to bring N. J. lines to Brooklyn	17.1 mi.	67.5 mi.
Excess length of City's line	.....	50.4 mi.
Ruling grade, electric section	1.6%	2.0%
Tunnel length, portal to portal	24,290 ft.	22,750 ft.
Excess length of Port Authority tunnel	.....	1,540 ft.
First Costs:		
Belt line, including power exchange yard, as described	$6,200,000	$42,000,000*
Electric section, including tunnel to Brooklyn	58,800,000	51,000,000†
Total cost, new line to reach Brooklyn	65,000,000	93,000,000
Excess cost, City's line	.....	28,000,000
Traffic Expectations:		
Net tons, annually	18,500,000	18,500,000
Cars (loads and empty) annually	1,340,000	1,340,000
Train miles required	910,000	1,620,000
Excess effort necessary under City's Plan, train miles	.....	710,000
Net ton miles required	477,150,000	973,150,000
Excess movement necessary under City's plan—net ton miles	.....	496,000,000
Unit Costs: (Including all operating expenses, interest on investment, taxes, etc.)		
Per car	$11.34	$15.17
Excess, City's plan	.....	3.83
Total cost, operation and overhead, annually	15,204,365	20,352,543
Excess, City's plan	.....	5,148,178
This difference in favor of the Port Authority's Plan, if capitalized at six per cent, amounts approximately to	.....	85,000,000

* Given as $32,000,000 in Jan. 23, 1922, report of Board of Estimate.
† Given as $53,000,000 in Jan. 23 report. E. or M.

The construction of classification yards at the junction points of the city's proposed belt line would not release any of the present classification yards.

Every railroad must have a classification yard within switching distance of the waterfront, in which to separate and classify the cars for various destinations, stations, sidings, etc., both for inbound and outbound movement and particularly in the case of outbound cars, which have to be made up in solid trains for principal destinations and in station order for way points.

A very serious ommission [in the city's report] is that no charge has been made for use of the Long Island and New York Connecting railroads or a line of similar purpose, which would be absolutely essential to distribute the tonnages which the city's engineers have assumed would move over the proposed belt line and through its proposed tunnel to Bay Ridge.

In working out the cost of the proposed operation, the City has assumed that nine million tons of freight would be distributed after reaching Bay Ridge, along the proposed marginal waterfront line in Brooklyn. The balance of the traffic allocated to its belt line and tunnel, amounting to eleven million tons, it leaves at the mouth of the tunnel on the Bay Ridge side, nothing being included for the cost of handling this freight between that point and its destination in Brooklyn, Queens or the Bronx.

Economy and Efficiency In Modern Highway Bridge Building

Increase in Loads Demands Closer Attention to Design in Details, Fabrication and Maintenance

By Howard W. Holmes
Bridge Engineer, State Highway Commission of Montana, Helena

MODERN types of motor vehicles with their heavy concentrated loads have given rise to much discussion as to proper loadings and impact factors to use in designing highway bridge structures. That many of the existing bridges are light and poorly designed has long been known to engineers, but only recently has the fact become known to highway officials and road users. There has resulted a crystallization of sentiment in favor of competent control of the design and construction of all bridges to be built in the future. It would seem, however, that a warning should be sounded against abuse of the desire for stronger bridges.

Undue increase of weight of future structures may result from present tendencies if they are not guided by proper regard for efficiency. Economy and sound business demand that not a single pound of unnecessary material be employed. Fundamentally, it would seem that a double obligation rests on the bridge engineer; to build highway bridges that will carry any load that may reasonably be expected to be imposed during the life of the bridge, and at the same time to build them at a cost that the community can afford.

In a great many sections of the country the latter obligation will make it impossible to provide for the greatest load that might possibly pass over the bridge during its life on the basis of the usual permissible working stresses. What then must be the first consideration under such circumstances? We must give most careful consideration to the probability of occurrence of possible maximum loads, and the effect of these loads on the structure. Full advantage must be taken of our knowledge of the properties of the materials entering into construction.

Take structural steel for example; has practice kept pace with the advances made in manufacture? Our answer must be in the negative. Today we are crediting this material with the same working stresses as when steel was first introduced into the art and when methods of control during manufacture were comparatively crude and unreliable. If a unit working stress of 16,000 lb. was then considered conservative practice, today such practice represents nothing short of economic waste. This reasoning leads to the first step in meeting the obligation as above submitted. We are

fully justified in discounting the likelihood of extreme loads, and provide for such loads at stresses but little below the elastic limit of the material.

We now come to a second phase of the problem. Main members are not fully efficient unless extreme care be used to develop their capacity by properly designed details and connections. Further, strength is not the only factor to be considered. It is common to see structures whose main members are amply sufficient but are detailed and braced in such way that traffic movement will induce dynamic stresses greatly in excess of the live-load stresses provided for. The stresses may also be increased greatly, or even doubled, through neglect in guarding against eccentricity of stress.

Many structures are today being built with suspended floors and without end floor beams. We see portals and sway frames gripping but one face of the members they connect. Rivets are laid out so that some cannot be driven effectively. These defects, together with a multitude of others, all tend to tax the material far beyond the stresses that would result from any conceivable live load.

Construction, Workmanship and Maintenance

A third thought relates to shop work and erection. The modern bridge works is equipped to execute work calling for any reasonable degree of refinement, and simply asks that the requirements be definitely outlined in advance. A well-designed structure may be so fabricated and erected as to cast serious doubt upon the propriety of becoming too enthusiastic over the problem of assumed design loadings and impact allowances. Some specifications governing shop work and erection will nullify all attempts to develop a proper and economical design. The engineer, if he be rightfully considered as such, must have had experience in actual shopwork and erection operations in order that he mav fulfill his dual responsibility of assisting both the contractor and the public in securing a structure so built as to perform in actual service the work the designer intended it should.

Finally, we must not lose sight of maintenance. Consideration of practical and effective maintenance must begin in the designing room. Details must be such as to prevent the lodgment of débris and to permit of easy access with a paint brush after erection. Periodical inspection must be carried out, and minor repairs not neglected from year to year as is the prevailing custom. Steel bridges should be kept well painted, and the paint used should be purchased on a definite specification embodying features known to be particularly applicable to the purpose—the protection of structural steel exposed to extremely severe conditions.

While it may be reasonably assumed that live loads will increase, it is equally reasonable to assume that the distribution of such loads will not greatly vary from assumptions used in present-day design. Frequency of application of excessive loads must be considered.

Much is heard today of military loads. When considering these, the limits of mobility must not be lost sight of. A 12-in. howitzer equipped with shoes will impose a load of about 22,000 lb. on the two front wheels. The 75-hp. caterpillar tractor adopted as the haulage unit for this howitzer weighs 25,000 lb. It would seem that even allowing for a material increase in the weight of heavy artillery, the typical 15-ton truck loading is ample for present-day design.

As to impact, present-day theories tend to resolve into a question of vibration rather than the dynamic effect produced by rough surfaces or the passage of a wheel over a single obstruction. The remarks already made about rigidity apply here with even greater force than in the case of load-carrying capacity. Investigation along most rational lines will disclose that an allowance of 25 per cent in connection with the floor design should be ample to care for the impact increment.

There are many locations where the concrete arch will be found to be the most economical type of structure. The determining factors will be, suitable foundation and construction materials; if these can be had at reasonable cost future live loads need not cause much apprehension. This applies particularly to the earth-filled spandrel type. Since the matter of clearance is usually an important consideration in highway work, arches of low rise must be resorted to, making the earth-filled spandrel type extremely economical. Properly designed arches and suitable foundations combine to produce a structure calling for practically no maintenance in so far as the structure itself is concerned.

To conclude: We must build bridges that are capable of carrying the traffic and at the same time not lose sight of the fact that there is a limit to the public purse. The solution of this problem lies in giving more attention in the future to details of design and erection, and in crediting the material with its full stress-carrying capacity within known limits of safety. If these things are done our highway bridges will meet all conditions of loading that may be reasonably expected, provided intelligent maintenance is made a part of our road-building program and not overlooked when funds are apportioned for highway development.

California Counties Place Weight Limit on Auto Trucks

THREE COUNTIES in Southern California, Riverside, San Bernardino, and Orange, have recently passed ordinances limiting the gross weight of any four-wheeled vehicle to 22,000 lb. The weight on six wheels, under the new ordinances, is limited to 30,000 lb., and the limit for a truck with two trailers is 36,000 lb. gross.

Last year the California State Supervisors Association urged the highway commission to limit gross loads on public highways to 20,000 lb. Since then local organizations have taken up the same request, the most recent endorsement being from the Tulare County Taxpayers Association, which adds the suggestion that no more franchises should be granted to motor carriers in territories now being served by other motor or rail routes, until the legislature shall have had opportunity to (1) enact laws protecting the highways from excessive weight and speed and (2) assess against motor vehicles fees that are in proportion to their wear and tear on pavements. The purpose of this suggestion is to release the general taxpayer from the burden imposed on him by highway reconstruction and maintenance made necessary by the heavy automotive traffic to which objection is made.

The state law in California permits as a maximum a gross weight of 30,000 lb. on four-wheeled vehicles and 40,000 lb. on six-wheeled vehicles provided axles are at least 96 in. apart and there is not more than 800 lb. on each inch of rubber-tire width.

ENGINEERING LITERATURE

Office Circulation of New Literature

BY RUTH CANAVAN
Librarian with Metcalf & Eddy, Boston, Mass.

That all members of our staff may keep themselves informed with respect to up-to-date developments in the engineering field, as set forth in current literature, the periodicals received at this office are circulated according to the following plan:

A list was prepared of all the men interested in any or all of the magazines received. This was typewritten in multiple on slips headed "Circulation List—Please check your name and pass this on." One of these slips is pasted by the librarian upon the front cover of each magazine as it is received. Note is then made of the page numbers of articles of especial interest against the names of those to whom they would appeal. Some names are crossed off the list. The magazine is then ready for circulation. It is placed upon the desk of the man at the head of the list or, in his absence, upon the next man's desk. He looks the magazine through, checks his name and passes it on. Or, in case he finds that he wants to read it more carefully he takes it home for one night. If he discovers data which should be abstracted he makes note of the fact at the bottom of the slip, or if he finds reference to books, bulletins or other matter which he thinks should be added to the library, he makes note of that fact. The second day he must pass the magazine along to the next man on the list. Some delays were anticipated, but the eagerness of the individuals to get each his turn promptly has taken care of this difficulty. The last man on the list returns the magazine to the librarian, who sees that all the names have been checked, takes care of the requests at the foot of the slip, and files the magazine in the current periodical stack.

To keep everyone posted, also, as to newly acquired material in the library a sheet prepared in duplicate and headed "Recent Acquisitions" is put up in the drafting room and in the library. Upon these sheets are typewritten the titles of all books, bulletins, pamphlets, etc., as they come in, the date of receipt, filing number, and in the case of books, the name of the purchaser. When the sheets have been filled they are taken down and a new listing started. The completed lists are turned over to the senior partners for their information and are afterward returned to the librarian, who destroys one copy and files the other in a binder, to serve in cumulative form as the library acquisition list.

Maryland Health-Engineering Bulletins

ENGINEERING BULLETIN NO. 1, MARYLAND STATE DEPARTMENT OF HEALTH—Robert B. Morse, Chief Engineer, Baltimore, Md. Paper; 6 x 9 in.; pp. 127; illustrated.

The engineering staff of the Maryland State Department of Health has been doing notable research work. Some of its studies of more than local interest have been reported from time to time in various technical journals, including *Engineering News-Record*. Ten of these, most of them dealing with statistical and other studies of the quality of water, or with storage, coagulation and filtration, are reprinted in this bulletin. Mr. Morse states that if the reception of this number is favorable others will follow. The value of the material and the convenience of having it thus assembled from scattered original sources warrants the enterprise. Commendation is also due to the practice of making individual papers immediately available by publication in some technical journal instead of holding then until enough to make a bulletin are available. It should be noted that some of the studies were made jointly with specialists not connected with the Maryland Department of Health, thus adding to the breadth of the investigation.

Ketchum's Mill Buildings Rewritten

REVIEWED BY R. FLEMING
American Bridge Co., New York City

THE DESIGN OF STEEL MILL BUILDINGS: The calculation of Stress in Framed Structures—By Milo S. Ketchum, C.E., Consulting Engineer; Mem. Am. Soc. C. E. Fourth Edition, Rewritten. McGraw-Hill Book Co., Inc. Flexible; 6 x 9 in., pp. 632; illustrated. $6, net postpaid.

The first edition of Ketchum's "Steel Mill Buildings" was the pioneer work of its kind and at once met with a favorable reception. Subsequent editions were enlarged. (See reviews: *Engineering News*, Oct, 15, 1903; Dec. 13, 1906; March 13, 1913.) Several entire chapters have now been added, the others rewritten, with new matter inserted. About half the cuts are new and many of the others redrawn. The present edition has more than twice the content of the first edition. It is practically a new book.

The book is written, the author states, to serve as a textbook in structural engineering and also as a book of reference for engineers. Part I, Stresses in Framed Structures, and Part II, Deflections of Structures and Stresses in Statically Indeterminate Structures, were probably written primarily with the classroom in mind. The author has admirably presented a comprehensive course of study in a clear and concise manner. A chapter on Influence Diagrams and a section on Oblique Loading of Beams are observed in Part I. The 80-page chapter of Problems is worthy of special mention. The method of presenting a solved problem followed by a similar one unsolved is highly commendable. Any student able to apply the methods of solution given for the 40 problems has a pretty thorough knowledge of stresses in statically determinate structures.

Area Moments have a prominent place in Part II. The deflection of framed structures is taken up at length and the slope deflection method of obtaining stresses in stiff frames rather briefly. A chapter is devoted to Problems in Higher Structures. The reviewer notes that for the approximate determination of wind stresses in the frame of a six-story building the author follows a decidedly better method than the one he gives in his "Structural Engineers' Handbook."

The 18 chapters of Part III, Design of Steel Mill Buildings, cover a wide range, giving not only data for designing buildings and proportioning members but also illustrations of specific examples. The chapters on Roof Coverings, Floors, Doors, Windows and kindred sub-

jects bring condensed information from many sources that will prove valuable to the engineer. Several "Examples of Industrial Buildings" are given in a chapter with that heading. Just here it may be stated that in common with most textbooks, designs and details shown do not always represent the latest practice. (This is not altogether the fault of authors. Fabricating firms are reluctant to give out for publication examples of their latest thought.) For instance, on p. 422 is shown a cross section and part longitudinal section of the Steam Engineering Building at the Brooklyn Navy Yard. The building was erected in 1900. (See *Engineering News*, April 25, 1901, for description.) It was extended in 1917, and while the outlines of the old building were followed changes were made embodying what had proven to be better practice. An illustration of the extension would have been more appropriate than the one showing the old portion.

Some of the details shown in Part III have been abandoned. The angle purlin (p. 406 and elsewhere) is turned the weak way of the angle. From the standpoint of fabrication undue stress is laid upon bringing purlins at panel points. It is often preferable to proportion the top chord for bending rather than to increase the number of truss members in order to bring purlins at panel points.

General Specifications for Steel Frame Buildings are given as an appendix. The 211 paragraphs can be read with profit by any one at all interested in steel frame buildings. A question that arises, especially to the engineer engaged in competitive design, is: Are not the specifications in some paragraphs needlessly severe? The reviewer believes that they are. Rollers or rockers under roof trusses on masonry walls need not be used until a span of 90 ft. instead of 70 ft. is reached. The wind pressures of 20 lb. and 30 lb. can be reduced to 15 lb. and 20 lb. The value of field bolts in shear can be increased from 6,667 lb. to 9,000 lb. and their use in field connections can be extended beyond attaching purlins and girts. Connections need not always be of sufficient strength to develop the full strength of the member. If ¾-in. rivets are used in a roof truss and $\frac{5}{16}$-in. be the minimum thickness of metal allowed, the minimum angle will be 2½ x 2 x $\frac{5}{16}$-in. There is little advantage in connecting the angle for its full tensile strength when it is subject to but 5,000 or 6,000 lb. in tension. A minimum depth of rolled beams in floors of $\frac{1}{24}$ instead of $\frac{1}{20}$ the span is sufficient. But the depth of beams and channels used as roof purlins should not exceed $\frac{1}{32}$ instead of $\frac{1}{40}$ the span. A side lap of 1½ instead of 2 corrugations is enough for corrugated steel roofing. Flashing can be of same gauge as the covering instead of always No. 20.

Anchor bolts should be shipped in advance by the steel-contractor and set by the mason. When existing structures are to be removed it is usually preferable to all concerned that the work be done by the owner instead of the contractor. The purchaser is seldom willing to pay for two coats of paint after erection.

A paragraph should be added specifying live loads to be carried by floors of factories, machine shops, power houses and other industrial buildings. It would also be well to have a paragraph regarding assumptions to be made for shafting carried by the bottom chords of roof trusses. Several paragraphs could be omitted as belonging more properly to the classroom.

The personal equation always enters into the selection of matter presented in a technical book. It also enters into the comments of the reviewer. A chapter, Theory and Practice, could well be added to a book of this kind. Prof. Ketchum understands both and knows that there is no conflict between sound theory and good practice. But the engineer fresh from college halls is confronted with the assertion that theory and practice are separate and distinct entities. As proof of this, structures are pointed out to him that have been built by "practical" men and that do not seem to accord with what he has been taught. A few pages from the professor on this subject would be welcomed. Some of the many minor points which the engineer is constantly meeting and on which he derives little help from textbooks could also be taken up in a chapter of this kind.

In conclusion: Professor Ketchum deserves the thanks of the engineering fraternity for bringing together such a wealth of material. No engineer who has anything to do with steel buildings is fully equipped for his work without "The Design of Steel Mill Buildings." It is an essential addition to his library.

Metcalf and Eddy's Sewerage Condensed

SEWERAGE AND SEWAGE DISPOSAL: A Textbook by Leonard Metcalf and Harrison P. Eddy. First Edition. McGraw-Hill Book Co., New York and London. Cloth; 6 x 9 in.; pp. 598; illustrated. $5.00.

In response to repeated urging, the authors of the monumental three-volume treatise on "American Sewerage Practice," published in 1914-15, have produced a "textbook" which promises to be equally successful within its intended field. The authors state that the present single volume contains "little" not given "in much greater detail" in the three volumes. This is too modest, for the "textbook" gives later information and conclusions than does the treatise. The present volume, like the earlier three, has had the benefit of the large experience of John M. Goodell, formerly editor of the *Engineering Record*, who did the larger part of the condensation.

The authors appear to have entered upon the preparation of this "textbook" with reluctance and to view the result with some question because they "are engineers, not teachers" and thus the book "reflects the engineer's rather than the teacher's viewpoint." Elsewhere in their Preface they say that they "finally decided to prepare a book giving the information which they consider it desirable for the young student to acquire before taking up work in the field," and that they felt "under obligations as professional engineering specialits to do their part in smoothing the way for the first steps taken by engineering students in this branch of engineering." These statements are sufficient justification for the production of a textbook on this subject by practicing engineers, especially when they have a successful treatise of their own to base it upon. Although the teachers of engineering have had the textbook field almost wholly to themselves heretofore we think most of them will not object to giving practicing engineers a chance to show what they think, as quoted more exactly above, the student should know when he turns from the classroom to the field.

In view of the well known antecedents of this volume, it is unnecessary to outline its contents further than to say that is covers the various phases of sewerage design, including sewage disposal (which is given about half the space) and contains much on construction.

Cost data are omitted because of the disturbing effect of the war and for other reasons, but there is a chapter on Cost Estimating. A few pages on the theory and practice of sewer assessments seem to be needed. It would also be illuminating if dates were used more frequently in connection with citations of data and practice. The value of dates is indicated in at least two cases where they are given: in the remarks on the Paris and Berlin sewage farms, where the year 1910 suggests that material changes in practice that have probably occurred since then should be noted.

Finally, whether regarded as a "textbook" or condensed treatise, this volume deserves hearty commendation.

Freitag on Fire Prevention Revised

Reviewed by Clinton T. Bissell

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FIRE PREVENTION AND FIRE PROTECTION: as applied to building construction—Second Edition, Revised. By John Kendall Freitag, B.S., C.E. John Wiley & Sons, N. Y. Flexible; 4½ x 7 pp. 1038; illustrated.

The second and revised edition of this handbook covers the broad field of fire insurance, fire hazards, design, construction and protection, although treating more specifically of building construction. There are six parts: Fire Prevention and Fire Protection; Fire Tests and Materials; Fire Resisting Design; Fire Resisting Construction; Special Structures and Features; and Auxiliary Equipment and Safeguards.

[The first edition was revised at length by Prof. Frank B. Sanborn in *Engineering News*, Dec. 12, 1912, p. 1117, and briefly in the *Engineering Record*, Sept. 26, 1912, p. 336—EDITOR.]

The important changes in this revision have been in the provisions dealing with theaters and garages. In numerous other parts also, there are new data on design and standards for construction in accordance with methods of the last decade, superseding similar matter which appeared in the first edition. For a volume dealing with so many topics, the material changes from the original edition are comparatively few. It is to be regretted that the chapter on fire losses has not been brought up to date. The student of fire prevention and fire protection naturally is more interested in present-day conditions than in what the conditions were from ten to twenty years ago. The argument of the author that revisions for the purpose of up-to-date comparisons with governmental expenditures would be less striking than as the figures stand, is out of harmony with the concurrent statement in the preface that the annual fire loss in the United States for the five-year period 1915 to 1919 inclusive was about 40 per cent greater than during the period from 1900 to 1909 inclusive.

The book is based largely on quotations and extracts from various publications. The action of structural materials and the results of faulty construction design in the conflagrations of Baltimore and San Francisco are liberally extracted from reports on these conflagrations by competent authorities. Similar information regarding fires in numerous individual buildings, principally in New York but also in Pittsburgh and elsewhere, is given. This material adds considerably to the size of the volume, but is not of much importance.

To be of full value the Fire Protection Library, or list of books that for a good course of reading in fire insurance, might well have had the list as made in 1906 considerably increased. The writings of various authors on the general subject of fire prevention and fire protection since that date have been numerous and there was opportunity here to present a fairly full bibliography which would include the several valuable recent works on the subject.

One of the excellent chapters in the book is on the theory and practice of fire insurance. Here are given a brief history of the origin of fire insurance in America, the duties of the insurance agent, the method of rating, the tax that insurance brings to the whole country, and the method of reducing insurance as practiced by the stock companies, with brief reference to mutual company methods.

Under the reference to the fire resisting qualities of concrete and to the fire tests made by German and British authorities, the United States Geological Survey and others, it is unfortunate that this edition was completed too early to include the results of the co-operative fire tests of building columns made by the National Board of Fire Underwriters, the Associated Factory Mutual Fire Insurance Companies, and the United States Bureau of Standards at the Underwriters' Laboratories, as reported last year. This experimental investigation of the resistance of columns and of their fire resistive coverings, including concrete, is an especially interesting and valuable addition to the previous knowledge of the action of fire and water upon protected and unprotected columns. It is also regrettable that the results of the exhaustive tests on the fire resistance of concrete and reinforced-concrete floor slabs, as reported by the British Fire Prevention Committee in 1921, could not have been included, as they constitute an important addition to our knowledge of this subject.

The matter in the handbook, as revised or entirely new, on theater curtains, chimney construction, practical suggestions for reducing fire loss in factories, and on garages is timely and valuable.

The general style of the book is that of exposition and description. It will be found especially interesting to a reader who is familiar with the elements of fire protection engineering, and wishes to pursue by casual reading the story of fire, fire prevention and fire protection. It should be valuable also as a book of reference and as a guide in developing sound building construction and protection through proper equipment and in management.

A Great Architect and City Planner

DANIEL H. BURNHAM, ARCHITECT, PLANNER OF CITIES—By Charles Moore. In two volumes. Boston and New York. Houghton Miffin Co. Cloth; illustrated. 8 x 11 in. Vol. 1, pp. 260; Vol. 2, pp. 238. $20.

To engineers the subject of these handsome and interesting volumes is best known as a pioneer in tall office building construction, director of works, one of the creators of the Columbian Exposition, architect of several large railway stations, chief of which is the Union Station at Washington, and as a city planner. In the latter capacity, Burnham played a large part as a member of the committee that replanned the City of Washington in the early years of this century, but it was his experience, his associations and his inspirations gained in connection with the World's Fair that gave him his start in the city planning field, and that did much to spur him on in his later work on that magnificent conception, the Chicago Plan. Other city planning accomplishments outlined in these volumes

had as their scene West Point, Cleveland (as a member of a board), Manila and Baguio, and San Francisco. Much of his city planning work was done without fees, for the good of the cause and the country; and the same was true of other successful efforts here described. Nothing could better show the spirit of the man and his work than what the author of this biography calls Burnham's "own oft-repeated injunction, formulated in 1907, which has become the motto of city planners since that day." The words run:

Make no little plans; they have no magic to stir men's blood and probably themselves will never be realized. Make big plans; aim high in hope and work, remembering that a noble, logical diagram once recorded will never die, but long after we are gone will be a living thing, asserting itself with ever-growing insistency. Remember that our sons and grandsons are going to do things that would stagger us. Let your watchword be order and your beacon beauty.

The biography shows a life and deeds corresponding with such inspiring words. Most fortunately, too, the biography is written by one well fitted for the task, a man for years intimately associated with Burnham, and who prepared the Washington Plan report, edited the Plan of Chicago and, with Burnham, was a member of the National Commission of Fine Arts. Among the many fine illustrations in the two volumes are reproductions in color of some of the notable Washington and Chicago plan drawings by Jules Guerin, and reproductions of black and white drawings by F. Janin. Throughout the book there are many allusions and intimate word sketches and letters, as well as portraits, of the leading architects, sculptors, artists and art critics of Burnham's day, thus increasing the value of the biography as a contribution to the art history of the period, and particularly to the history of some of the larger aspects of the growth of city planning in the United States.

International Health Journal Suspended

With the November-December number, publication of the *International Journal of Public Health* was suspended. The *Journal* has been published in several languages at Geneva, Switzerland, by the League of Red Cross Societies. The League will continue to issue its *Bulletin*, with increased space for scientific information.

Standard Chimney Specification Improved

A thoroughgoing revision of the standard chimney specification (written in such form as to be available for adoption as a municipal building ordinance) has just been issued by the National Board of Fire Underwriters (76 William St., New York City). It was prepared largely by Prof. Ira H. Woolson, acting for a committee of the board. It is more precise in its specifications, and therefore safer, on a number of details of construction, while at the same time it makes all reasonable allowances for the use of different kinds of material. In general, clay flue lining is required in all chimneys except those for ordinary low temperature heating of dwellings. As against the prior edition of the specification, one-brick partition walls are now pretty generally required between flues. As the chimney is one of the key items in fire danger, being fourth on the list of fire causes in the country, the importance and value of this specification will be apparent. Every engineer concerned with building construction or maintenance will find it a necessary piece of file information.

Publications Received

AN ANALYSIS OF PUBLIC ACCIDENTS: 1921. National Safety Council, 168 N. Michigan Ave., Chicago, Ill.

BITUMINOUS PAVEMENT INVESTIGATION IN CERTAIN TEXAS CITIES—Part II. Asphaltic Concrete (Topeka and Modified Topeka) Uvalde Rock Asphalt, and Oklahoma Rock Asphalt. By Roy M. Green, Manager, Western Laboratories (Inc.), Lincoln, Neb.; Formerly Professor of Highway Engineering, A. and M. College of Texas. Paper; 6 x 9 in.; pp. 120; one half tone. Copies sent free on application to J. C. Nagle, Director Texas Engineering Experiment Station, College Station, Tex.

Although dealing primarily with Texas conditions this bulletin contains material of general interest. It is a continuation of Mr. Green's earlier bulletin on Bitulithic.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING: Report for 1921—New York City. Paper; 7¼ x 10 in.; pp. 205.

COMMISSION ON STATE ADMINISTRATION AND EXPENDITURES: Report to the Massachusetts Legislature, January 1922. By Robert T. Brady, Secretary, State House, Boston, Mass. Paper; 6 x 9 in.; pp. 102. Illustrated.

This Commission, consisting of three members of the Senate, five members of the House and five citizens, had as its chairman Edwin S. Webster, of Stone & Webster, Boston. It was provided with a fund of only $5,000. Mr. Webster, without expense to the State, placed at the service of the commission "a corps of engineers and specialists from his staff," the other members of the Commission state. The Commission submits recommendations for the consolidation of departments, abandoning of some activities and assessing the cost of others on the beneficiaries, for increased efficiency and other measures which it says would reduce by $10,000,000 a year the general tax levy of the State.

CONSTRUCTION, COST KEEPING AND MANAGEMENT: A Treatise for Engineers, Contractors and Superintendents Engaged in the Management of Engineering Construction—By Hulbert Powers Gillette, M. Am. Soc. C. E., Editor *Engineering and Contracting*, and Richard T. Dana, M. Am. Soc. C. E., Consulting Engineer, Chief Engineer, Construction Service Co. New York and London: McGraw-Hill Book Company, Inc. Cloth; 6 x 9 in.; pp. 572; illustrated. $3.50.

DEPARTMENT OF PUBLIC HIGHWAYS: Annual Report, 1919. Toronto, Ontario, Canada. Printed by Order of the Legislative Assembly of Ontario.

HANDBIBLIOTHEK FUR BAUINGENIEURE: Herausgegeben von Robert Otzen. Stadtebau von Otto Blum, G. Schimpff, W. Schmidt. Mit 482 Textabbildungen. Berlin: Julius Springer.

HANDBUCH FUR EISENBETONBAU: Dritte Neubearbeitete auflage. In Vierzehn Banden. Herausgegeben von Dr. Ingenieur F. Emperger, Oberbaurat Regierungsrat im Patentamt in Wien. Achter Band. Eisenbahn, Berg-Und Tennelbau, Stad-und Untergrundbahnen. Bearbeitet von R. Bastian, A. Kleinlogel, F. Kogler, A. Nowak. Mit 1197 Textabbildungen. Berlin: Wilhelm Ernst & Sohn.

MINERAL LANDS SURVEYING—By James Underhill, Ph.D., Mining Engineer, U. S. Mineral Surveyor for Colorado. Third Edition Revised. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 5 x 8 in.; illustrated. $3.50 postpaid; 21s. net.

Among "several additions" in this edition the Preface notes "the treatment of the direct solar observation" and a rewriting of the specimen field notes based on the "requirements of the office of the United States Surveyor General for Colorado." The volume is devoted to methods used in surveying mineral lands in the Western United States.

NEW JERSEY SEWAGE WORKS ASSOCIATION: Proceedings, 1921. Myron E. Fuller, 170 Broadway, New York City. Paper; 8 x 11 in.; pp. 24.

NEW YORK WATER POWER COMMISSION—Report for 1921. Frank M. Williams, State Engineer and Surveyor, Member and Secretary of Commission, Albany, N. Y. Paper; 6 x 9 in.; pp. 52.

NORTH DAKOTA SOCIETY OF ENGINEERS: Proceedings for 1920 and 1921. E. F. Chandler, Secretary, University of North Dakota. Paper; 9 x 6 in.; pp. 75.

ONTARIO HYDRO-ELECTRIC POWER COMMISSION: Report for 1919 and 1920, Vol. II. Toronto, Ontario. Paper; 9¼ x 6¼ in.; pp. 313.

PUBLIC HEALTH SURVEY OF LAFAYETTE AND TIPPECANOE COUNTY, INDIANA, 1921—By Murray P. Horwood, Ph.D. Chapter One, Water Supply. Lafayette, Indiana; Tippecanoe County Tuberculosis Association. Paper; 6 x 9 in.; pp. 23; half tones.

REAL MATHEMATICS—By Ernest G. Beck. Oxford Technical Publications. London: Henry Frowde and Hodder & Stoughton. Cloth; 8 x 5 in.; pp. 306. 103 figures in the text.

SASKATCHEWAN DEPARTMENT OF HIGHWAYS—Report for 1920-21. Regina, Sask. Paper; 7 x 10 in.; pp. 99; illustrated.

SYSTEM BUILDING AND CONSTRUCTIVE ACCOUNTING—By Raymond D. Willard, B.C.S., Member of Robert Douglas & Co., Certified Public Accountants. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 307; illustrated. $4. Designed primarily as a textbook on the installation of "accounting system for various lines of business activity."

TRUE NET SECTIONS OF RIVETED TENSION MEMBERS—By C. R. Young, Associate Professor of Structural Engineering (as below). Bulletin of School of Engineering Research, Toronto, Ont. Paper; 6 x 9 in.; pp. 213-44; illustrated.

THE UNITED STATES PUBLIC HEALTH SERVICE: Its Evolution and Organization—Reprint No. 661 from the Public Health Reports, May 27, 1921. Washington, D. C.; U. S. Public Health Service. Paper; pp. 16. 5c. from Superintendent of Documents, Washington, D. C.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Against Engineer Licensing Laws

Sir—In regard to the very decided drift in all states towards a license law for engineers, which the American Association of Engineers seems to be leading and pushing, I often wonder where the idea of licensing engineers originated and why all the propaganda in favor of it. In my observation of the operation of the law in various states in the South, infinitely more harm than good has been done. In some states a man must have resided for a period of time before being eligible. In others a man must pass an examination, which is entirely unfair in that it does not give proper credit to his experience. I know an instance where a man going into another state to accept a $7,000 position could not pass the examination.

Such laws are absurd and where does the engineer come in on it? You hear members of the American Association of Engineers say that it protects the public. As far as I know the public did not originate the demand for a license law for engineers, so why worry about it, especially as it is not clear where the public is being benefited?

Too much depends on the personnel of the board selected to administer such a law. A great many engineers are in highway work and I think the officials of the state highway departments are fully capable of selecting subordinates who are competent and who will safeguard the public without the need of a board to pass on a man's qualifications. It is my opinion that many engineers are drifting into the idea that licensing is a good thing without stopping to ask if there is another side to the question. I am not writing this for the sake of starting an argument, but am merely giving my sincere belief.

L. G. SMITH,
Bridge Engineer,
State Highway Department of Alabama.

Montgomery, Ala.
Feb. 2.

Arch Problems in the Palm Beach Failure

Sir—R. F. Ensey's report on the bridge failure at Palm Beach, Fla., in the issue of Jan. 26, p. 148, contains some valuable lessons for engineers. There seems to be a tendency among engineers to take greater and greater chances in the design and construction of concrete structures; and too often this tendency grows until an expensive disaster takes us back to safer and more conservative policies.

As to design: These arches of 63 ft. clear span have a thickness of 12 in. at the crown and 24 in. at the skewbacks. Also, the reinforcement is comparatively light. The theory of hingeless arches is based on the assumption that the modulus of elasticity of the material used is constant. Yet it is a well-known fact that the modulus of elasticity is different for different grades of concrete, and that for a given grade of concrete it is different for different unit stresses. When these facts are taken into consideration how is the designer to know the exact location of the resultant line of pressure? With a crown thickness of only 12 in. it is quite possible for this resultant to fall outside the limits of the arch. By choosing the ring type of arch instead of the barrel type the thickness could have been doubled or trebled without increasing the amount of materials required. It should also be remembered that arch theory involves the moment of inertia of the arch section, and here again the deeper section would have a great advantage over the barrel type. Had the spandrel walls been continuous over the entire span and securely tied to the barrel of the arch they would have greatly stiffened the barrel, but Mr. Ensey's report indicates that they were designed and constructed in such a way as to give little or no support to the arches.

It appears from one of the photographs that the centering was poorly designed. No provision whatever was made for taking care of lateral forces, and it is almost impossible to cast an arch without setting up lateral forces which act upon the centering. This defect is of special importance because of the manner in which the arch spandrels were filled.

I cannot agree with Mr. Ensey concerning the effect of filling the arch spandrels successively. If one side of an arch is completely filled while the other side remains empty the arch will certainly be deformed by this eccentric loading, and no amount of filling on the second half will overcome this deformation. If the material used for the fill were a liquid the deformation would be overcome when the loads on the two sides of the arch became equal. But with sand or any other material used for fills the greater part of the deformation would be permanent.

In the construction of any concrete structure subjected to high unit stresses the best of materials and the best of workmanship should be required. Mr. Ensey's report indicates that some of the concrete in the Palm Beach arches is of a very poor quality. It would be interesting to know just what tests were used to determine the fitness of the cement, sand and stone used in the construction of these arches. The report states that some of the concrete could be broken with the hands. It also states that the newest concrete was 26 days old. At that age concrete for arch construction should show high strength.

The report does not give much information concerning the foundations. It mentions that they were placed by means of a tremie. Anyone who has had much experience with a tremie knows how difficult it is to do good work by this method. There are times when the tremie offers the only practical method of placing foundations and this may have been the case at Palm Beach. It would be worth while to make a thorough examination of the foundations, but, from the evidence presented by Mr. Ensey, it seems to me that one need not go below the spring line of the arches to find the causes of the disaster.

C. C. CARPENTER.

Ada, Ohio, Jan. 31.

Sir—In the article on the Palm Beach failure, giving the report of Mr. Ensey and that of Mr. Howard, the cause of the failure is treated somewhat as a mystery, chiefly because of the disappearance of pier 9. From the meager details of the design it appears that the piers were founded on rock so soft that it was rock in name only. The softness of the rock, however, will scarcely account for the manner and extent of the failure. It appears to me from the descriptions given that the failure was caused by the thinness of the stratum of this soft rock, which in addition probably surmounted a comparatively soft material. If this soft rock had, underlying it, a hard rock the result would simply be some settlement and possible cracking of the arches. If my assumption of the rock condition is correct and the stratum was particularly thin under pier No. 9, this pier would puncture the stratum and in sinking through the layer of "rock" it would cause the failure of the adjacent spans, which would pull piers 8 and 10 in the direction of pier 9. During the first collapse the bond resistance of the dowels was not sufficient to pull pier 8 along with span 8-9, so that the dowels pulled out and left pier 8 standing with span 8-7.

This condition placed pier 8 into the position of an abutment pier with the unbalanced thrust of the arch exerting its pressure against it, which thrust being applied at a horizontal joint (the report states concreting was not continuous), in pier 8 below the water line, the pier failed at this joint because the adhesion of the section above to that below was not sufficient to resist the thrust. The failure of this pier caused arch span 8-7 to fail, pulling in the direction of pier 9, tending to overturn pier 7 in that direction; the bond of the dowels, however, being

overcome before overturning occurred, pier 7 remained tilted while the dowels pulled out.

While Mr. Howard's explanation, placing responsibility on method of filling, would account for excessive pressure, a factor of safety of four should have covered this unforeseen condition. Moreover, it would not account for the manner or extent of the failure.

Incidentally, I wish to differ with Mr. Ensey's criticism of the lightness of the arch ring. With a proper curvature of intrados and extrados an arch ring 12 in. thick at the crown and 24 in. at the haunches, properly reinforced, is perfectly good design for highway loading with span shown, and an analysis will show a factor of safety of four in the stresses developed. The fact that the dowels pulled out in all cases rather than fractured, indicates that there was not sufficient embedment to develop the bond, otherwise at least as many bars would have broken as were pulled out.

M. HIRSCHTHAL,
Concrete Engineer, Delaware, Lackawanna & Western R.R.

Hoboken, N. J., Jan. 31.

Sir—The editorial: "Arches and the Palm Beach Accident" in *Engineering News-Record* of Jan. 26 brings to mind the classical accident at Pont-y-pridd, South Wales, of more than a hundred years ago.

So far as I remember the story, the village bricklayer, named Edwards, was engaged to construct a bridge over the river Taff, and he designed and built it in one span with a high, thin arched center having heavy spandrels. This bridge collapsed by reason of the light center being pushed upwards due to the weight of the heavy spandrels. Edwards, nothing daunted, rebuilt the bridge to the same general design but made great circular openings through the spandrels, reducing their weight, which made it stable and the bridge stands today.

WILLIAM GORE,
of Gore, Nasmith & Storrie, Consulting Engineers.

Toronto, Feb. 1.

Sir—The American public in general and the engineering profession in particular are indebted to *Engineering News-Record* and its publishers, for the prompt and full details covering the failure of the Palm Beach concrete arch bridge, together with the valuable editorial bearing upon the subject, which strongly suggests the basic cause of this collapse.

It is noted with pleasure that the engineers of this structure plan to make a complete statement when investigations are finished.

The first-hand report of your special investigating engineer, R. F. Ensey, published simultaneously with part of the report of the engineers themselves, discloses sufficient information, in my opinion, to establish the cause of the failure of this structure. Whether the bridge would have stood up, or been self-supporting, if its erection had been carried out properly is an interesting question.

The collapse of this structure is due, according to the findings of your expert, to poor engineering, involving both faulty design and failure to enforce the specifications. It is unnecessary to give time and space to a discussion of the second cause of failure, since the engineers in their report repeat this in their statement, "This filling was placed in a manner which produced unsymmetrical loading of the arches, contrary to the stipulations of the specifications." The inference is, that if the violation of a *major* stipulation of the specifications—one so vital to the integrity and safety of the entire structure—was permitted and tolerated, then other stipulations of a comparative minor character must have shared a similar fate.

The lack of reinforcement in the piers indicates that no consideration was given to the fact that the piers, in a system of arches, are not *merely supports* of the structure, but *are integral parts of the elastic system*, and are component parts of such system, together with all its arches. A practice too common in the design of a system of arches is the consideration of only one of the arches constituting the structure and applying to it the usual theory of the elastic arch, as if it were a single-arch design. This is the usual practice, unfortunately, when all the arches of a series are identical or differ slightly. When a system of arches is made up of arches differing considerably in size, an arch of each size-group is selected and the usual elastic theory of design applied to this one representative of the group.

In the case in point, it appears that no attention whatever has been paid to the fact that a system of arches should be designed as a whole and not as a single arch, and that the elasticity of the piers, as well as that of the soil upon which the piers rest, all enter intimately and decidedly into the design of arches in series. Such considerations are of the highest importance and no design of this character can be passed upon as safe or reliable, where such methods have not been applied correctly.

It is high time that the engineering profession realized that the correct design of a system of arches is not an everyday task; it is a very serious matter, and should not be treated lightly. It means human life. It means "an indictment of the whole profession"; and should be done only by "its trusted builders," as you state in your editorial.

It is well known that the theory of virtual work applied in the design of a single arch holds only so long as the supports for the arch are unyielding or practically so; but this is not the case with an arch supported by piers, when one of a series. This theory, therefore, in spite of its simplifications, short-cuts, etc. should not be applied to structures of several arches.

Some years ago (1912) the above facts were explicitly set forth, and the proper theoretical analysis covering multiple arch designing was presented for the first time in this country by A. C. Janni in a paper presented Jan. 13, 1913, before the Western Society of Engineers. This method, now well known as the method of the ellipse of elasticity, and widely used, was again published in still more detail in Prof. George A. Hool's "Reinforced-Concrete Construction," Vol. III, Chap. VIII.

Another important factor in design, which is prompted by the many pictures and actual examples of multiple arch bridges in reinforced concrete, is that these structures almost generally have piers of uniform dimensions or thereabouts. Convenience, aesthetic design, and above all safety itself, demand that in a bridge composed of a series of arches, its piers should not be all of the same dimensions, but should vary in size, weight and resisting power. Piers of two sizes should enter into every design of a multiple series:

The regular or standard pier, and the abutment pier.

Regular piers are those which are of such dimensions as to enable them to stand the ordinary combined reactions of two adjacent arches. Abutment piers are those of larger dimensions, which enable them to withstand, if need be, extraordinary reaction of one arch in emergencies, regardless of the presence or absence of the adjacent arch on the opposite side of this pier. These abutment piers should enter the series in the order, say, of 3,6,9, or vary to meet the conditions imposed by symmetry, character of the stream bed, foundations, etc. The analogy between these abutment piers in a series of arches and a fire wall in a large building or series of buildings is obvious.

The importance and utility of the abutment piers are obviously to forestall a complete disaster, from approach to approach, in case one or more arches, for some reason or other, collapsed, thus confining the damage between two abutment piers. An admirable example of their use is found in the beautiful Kingshighway Viaduct in St. Louis, Missouri.

As stated before, aesthetic consideration also demands designs of this character, for a succession of arches of like dimensions is always unpleasing and monotonous. The introduction of an irregular size of pier, at intervals, immediately breaks the monotonous continuity and affords beauty with the impression of strength.

PHILIP AYLETT,
Valuation Department, New York Central R.R.

New York, Feb. 8.

NEWS OF THE WEEK

New York, February 16, 1922

Federal Officials Define Trade Association Activities

Indicate Functions Which Do Not Violate Law—Conditions for Collecting Statistics

Concluding discussions which have been in progress for some months the Department of Commerce has made public letters recently interchanged between Herbert Hoover and the Attorney-General, Harry M. Daugherty, regarding the legality of various types of activities of trade associations. The most important points cover the collection and dissemination of statistics. Provided these be given to the public at the same time that they are distributed to the members of the association, the Attorney-General holds that their distribution would not be illegal. Nine other types of activities are covered in the questions put to Mr. Daugherty by Mr. Hoover.

The questions asked by Mr. Hoover are as follows: Whether a trade association may

1. Provide a uniform cost accounting system for its members.

2. Advocate and provide for uniformity in the use of trade phrases and trade names for the purpose of ending confusion in trade expressions.

3. Advocate and provide for the standardization of quality and grades of product; standardize technical and scientific terms, processes of production and machinery; co-operate with its members in determining means for the elimination of wasteful processes in production and distribution and for raising ethical standards.

4. Collect and disseminate to its members credit information as to those using the products of the industry.

5. Arrange for the handling of the insurance of its members, including fire, industrial, indemnity, or group insurance.

6. Engage in co-operative advertising for the promotion of trade of the members; engage in such form of promotion by furnishing trade labels, designs, and trade-marks for the use of its individual members.

7. Engage in the promotion of welfare work in the plants or organizations of its members.

8. Handle legislative rate litigation and railroad transportation questions that may affect the particular industry.

9. Undertake the promotion of closer relations between the particular industry and the federal and the state departments of government.

10-A. Collect statistics from each member showing his volume of production, his capacity to produce, the wages paid, the consumption of his product in domestic or foreign trade, and his distribution thereof, specifying the volume of distribution by districts, together with his stock, wholesale or retail.

B. Compile the information in each report into a consolidated statement showing totals.

C. Provided the information received from the members as well as the combined information is not previously given by the association to any other person, file the combined statement with the Secretary of Commerce for distribution by him to the members of the association through the public press or otherwise and to the public generally and to all persons who may be in any way interested in the product of the industry.

11-A. Collect information regarding the prices received for the products sold, specifying the volume of each grade, size, style, or quality, as the case may be, and the price received for the volume so sold in each of the respective districts where the product is sold.

B. Without making known to any person the individual price reports of any member, consolidate all of the reports into one, and show the average price received for the total volume of each grade, brand, size, style, or quality, as the case may be, distributed in each district covered by the distribution statistics for the period covered by each individual report.

C. Send the compiled report as to average price to the Secretary of Commerce, to be by him distributed to the public and to any or all persons who may be interested in the particular industry making the report.

Closing the enumeration Secretary Hoover specifically asked whether trade associations might engage in these activities "without violating the law, provided the organization and the activity engaged in are not for the purpose of hiding or concealing some agreement, contract, etc., to actually restrain trade or otherwise violate the anti-trust laws."

Attorney-General's Reply

In his reply to Mr. Hoover, the Attorney-General made exceptions to only two of the activities. He declared that as to uniform cost accounting systems, associations must not agree on uniform cost of any item of expense, such as a stumpage figure in lumbering operations. As to uniform trademarks it was his view that they would tend toward securing a uniformity of price. Mr. Hoover, in a second letter, informed the Attorney-General that the original question should have been worded to inquire into the legality of associations actually designing dissimilar trademarks.

As to all other activities cited by Mr. Hoover, the Attorney-General held that, as put by Mr. Hoover, they are not illegal. His words are as follows:

"I can now see nothing illegal in the exercise of the other activities mentioned, *provided always* that whatever is done is not used as a scheme or device to curtail production or enhance prices, and does not have the effect of suppressing competition. It is impossible to determine in advance just what the effect of a plan when put into actual operation may be. This is especially true with reference to trade associations, whose members are vitally interested in advancing or, as they term it, stabilizing prices, and who through the medium of the associations are brought into personal contact with each other. Therefore the expression of the view that the things enumerated by you, with the exceptions [as to cost figures and trademarks] stated, may be done lawfully is only tentative; and if in the actual practice of any of them it shall develop that competition is suppressed or prices are materially enhanced, this Department must treat such a practice as it treats any other one which is violative of the Anti-Trust Act."

Large Highway Program for Alabama in 1922

The State Highway Commission of Alabama, following the passage by a large majority on Jan. 30 of the $25,000,000 highway bond issue has authorized W. S. Keller, state highway engineer, to advertise for bids for construction of all projects which are ready to be built. This will mean the immediate advertising for bids on 17 projects with a total length of 202.53 miles, and a total estimated cost of $2,950,052.

The report of the state highway engineer shows further that there are 12 additional projects with a total length of 129.6 miles and a total estimated cost of $2,095,415 which have already been approved by the U. S. Bureau of Public Roads, and these projects will be ready to advertise for bids as soon as plans have been completed.

A number of large projects now in the proposal stage will also be pushed forward and contracted for during the coming year.

Coroner's Jury Holds Nine Men for Knickerbocker Collapse

Blaming the collapse of the Knickerbocker Theater roof in Washington, D. C. on Jan. 28 upon faulty designing construction and inadequate supervision and inspection, a coroner's jury, after taking testimony for a week, reported on Feb. 14 that nine men connected with the construction work be held for action by the Federal grand jury. The nine ordered held are:

R. W. Geare, the architect of the theater; John H. Ford, the engineer who prepared the design of the steel framework as built; Morris Hacker, building inspector of the District of Columbia at the time the theater was built; Donald Wallace, general foreman for the contractor; Frank L. Wagner, the general contractor for construction of the theater; Richard G. Fletcher, foreman for the Hammett Fireproofing Co., subcontractors for the cement and mason work; John L. McDonald, subcontractor for erection of the steel; Thomas L. Costigan, formerly engineer and computer in the building inspector's office, who approved the plans for the theater; and Julian R. Downman, formerly assistant building inspector.

Indianapolis Planning Commission Begins Active Work

Active work on a city plan for Indianapolis begins this month with the employment of Robert H. Whitten, of Cleveland, Ohio, as consulting engineer to the City Planning Commission. Mr. Whitten is to devote at least ten days a month to the Indianapolis plan and is to be paid $400 a month.

Akron Chooses City Manager

Effective Feb. 1, the City Council of Akron, Ohio, has appointed Henry C. Campbell as chief administrative officer or city manager, at $7,500 a year, to fill the vacancy caused by the Council in discharging W. J. Laub, who was paid $10,000. Akron is the largest city in the United States having a city manager, but Cleveland will have one early in 1924. Mr. Campbell is a native of Akron, a college and law school graduate. Recently he has been manager and secretary of the Akron Home Owner's Association and vice-president and general manager of the Coventry Land & Improvement Co.

Denver Water-Works Problems Under Survey by Engineers

A review of the present and future water supply problems of the Denver Water-Works is to be undertaken by a board of three consulting engineers. Two have been selected, Dabney H. Maury, Chicago, and Herbert S. Crocker, Denver, but the third engineer, an authority on irrigation, is still to be named. The appointment of the board follows a recommendation made by the Civic and Commercial Association shortly after the defeat of a bond issue for improvements. A statement of the water needs of the city by a disinterested engineering board is sought to create confidence in the citizens as to the needs of the plant.

Reject Plan for New Official To Study Railroad Needs

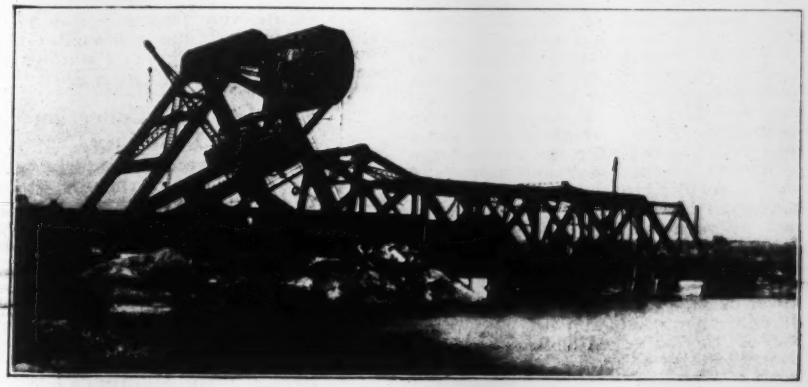
At its mid-year meeting held last week the National Council of the Chamber of Commerce of the United States refused to submit to a referendum vote of the membership a recommendation by its railroad committee that there be created a new government official who should be appointed by the President and bear the title of Commissioner General of Transportation. This official was to be charged with the duty of studying transportation problems and needs from the viewpoint of the general public and of representing the public at hearings before the various governmental bodies that deal with transportation matters.

The proposal was supported by George A. Post, president of the Hudson River Bridge and Terminal Co., and chairman of the railroad committee, and by Alexander W. Smith of Atlanta, another member of the committee. The opposition was led by Alba B. Johnson of Philadelphia, president of the Railway Business Association. Disapproval was voiced also by Herbert Hoover, Secretary of Commerce and Howard Elliott, president of the Northern Pacific R.R., both of whom believed that existing laws and agencies looking to the same end have not yet had time to demonstrate their utility.

New Type of Bascule Bridge At Detroit

At the crossing of the Wabash RR. over River Rouge, Detroit, a bascule bridge of radically new type has just been built to replace an old swing bridge. The photograph reproduced herewith, taken last week, shows the new structure completed.

The new bridge was made necessary by improvement of the channel to a width of 300 ft. with depth of 20 ft., which required a width through the draw of 125 ft. The old structure was a single-span swing bridge about 180 ft. long with a pivot pier in the center of the stream. The new structure is a single-lead double-track bascule bridge designed for Cooper's E50 loading, with 162-ft. lift span. The total length is 291 ft. including A-frame and deck plate-girder approach. In addition to carrying Wabash trains this bridge is used by the Baltimore & Ohio, Detroit & Toledo Shore Line, Pere Marquette, and Pennsylvania R.R. A three day count showed 113 trains in 24 hours or a train every 13 minutes.



WABASH RAILROAD'S NEW TYPE OF BASCULE BRIDGE

The foundations for the A-frame at the trunnion end of the bascule were placed west of the original west abutment, the rest pier between the pivot pier and east abutment. Foundations were carried to rock 88 ft. below the base of rail by pneumatic caissons. Hydrogen sulphide gas was encountered a short distance above the rock, at about 30 lb. air pressure in the caissons; this gas gave no difficulty when the pressure was raised to 40 lb.

The steel structure was erected with the leaf lifted, leaving out certain floor beams and stringers giving a portal for the passage of trains. Just before the leaf was lowered the old draw span was rolled upstream on temporary bents. When the leaf was lowered the omitted members were then erected and the approach girder span set in place, all of which was done in 7¼ hr. Steel erection was started July 1, 1921, and leaf closed Jan. 26, 1922.

The lift is operated by the strut supporting the counterweight traveling down an inclined track. The operating controls are completely interlocked. Safety brakes to hold the strut fixed to its track are provided. The motive power is supplied by two 100-hp. 440-v. A. C. motors, and in emergency operation by a gasoline engine.

To give the channel its full width it is now necessary to remove the old pivot pier and west abutment.

Congress to Consider New Federal Aid for Roads

Hearings to Begin on Woodruff Bill—Highway Officials Oppose Soldier Bonus from Road Revenues

(*Washington Correspondence*)

Active consideration of legislation authorizing appropriations for federal aid roads has begun in the House of Representatives. The Woodruff bill, which authorizes the appropriation of $100,000,000 annually for a period of five years, is to be the basis of the work which will be done by the committee on roads. Hearings on that bill probably will begin Feb. 17. Since the President has expressed the earnest wish that the annual expenditure be not greater than $75,000,000, and has indicated that he would not be displeased if it were found that $50,000,000 were adequate, it is regarded as probable that the committee will reduce the amount of the annual appropriation carried by the Woodruff bill.

W. C. Markham, legislative representative of the American Association of State Highway Officials, states that his organization is making a careful survey of the amounts which each state can absorb and will not ask for more federal aid than can be taken up within the year. He points out, however, the necessity for planning ahead, especially with the 7 per cent system called for in the Act of Nov. 9, 1920.

The American Association of State Highway Officials, Mr. Markham says, will fight to the last ditch against the proposal to raise soldier bonus money by federal taxes on automobiles and gasoline. Such action, he points out, would usurp the sources of taxation on which the states are relying for their maintenance funds. Fifteen states already have levied a gasoline tax. Three legislatures are in session at this time which will act on bills providing a gasoline tax. Next winter the legislatures will meet in thirty-four states. Mr. Markham predicts that practically every state will resort to this source for funds for road construction and maintenance. Were the Federal Government to add another tax on gasoline and automobiles, the burden would be out of proportion and would cause a very unfavorable reaction. Mr. Markham makes it clear that the highway officials are not fighting the soldier bonus. The organization is convinced, however, that this money should be raised from sources.

McClellan and Junkersfeld Form New Engineering Corporation

Announcement was made last week of the incorporation of McClellan & Junkersfeld by William McClellan, Peter Junkersfeld and Horace T. Campion for engineering and construction work. The new firm, a Delaware corporation, has $1,000,000 authorized preferred stock and 2,500 shares of no-par common stock; all the financing has been arranged for. Offices are temporarily at 141 Broadway, New York City. The new organization will specialize in power plants, transmission systems, water powers, electrification of railroads, and general industrial and utility engineering and construction.

Mr. McClellan is president of the American Institute of Electrical Engineers. His early experience was as engineer in charge of construction with the Philadelphia Rapid Transit Co. For several years he was a managing engineer with Westinghouse, Church, Kerr & Co., participating in the Pennsylvania Terminal engineering and construction and electrifying the Rochester division of the Erie R.R. For several years he was electrical engineer and chief of the division of light, heat and power of the Second District Public Service Commission of New York. He has been associated with the Cleveland Electric Illuminating Co., for about eight years and was for two years one of its vice-presidents. During the war he was director of the Intercollegiate Intelligence Bureau, an organization of more than 200 of the principal colleges of the United States. For a time he was Dean of Wharton School of Finance and Commerce of the University of Pennsylvania.

Worked on Army Projects

Col. Junkersfeld, from 1895 to 1919, was associated with the Chicago Edison Co. and its successor the Commonwealth Edison Co. During this time he was associated with all the large power work of these companies and when he resigned was assistant vice-president, supervising contracting, engineering, construction and operation work. During this long service he was intimately identified with all the design and construction of many large stations, aggregating 600,000 kw., together with the transmission lines, substations, distribution system and other physical properties. In 1916-1917 he was president of the Association of Edison Companies. In June, 1917, Col. Junkersfeld entered the army and was successively major, lieutenant-colonel, and colonel in the Construction Division, U. S. Army, engaged in constructing cantonments, camps, hospitals, port terminals, warehouses, munition plants and other war construction. Soon after the close of the war he became engineering manager for Stone & Webster, in charge of the engineering department, and an executive of the division of construction and engineering.

Mr. Campion's early business life was spent in engineering and construction work of the Philadelphia Rapid Transit Co., where he was assistant chief engineer in charge of the design and construction of all car barns, power houses, shops, parks and other physical property. In 1903 he entered the general construction field and has to his credit the design and construction of numerous buildings of steel and reinforced concrete of every type, construction of the forebay work of the Ontario Power Co., substations for the Philadelphia Rapid Transit Co., extensive paper mills of the Warren Mfg. Co. at Milford, N. J., shops at Ardmore, Pa., and terminal stations. He is now associated in the engineering for the new stadium of the University of Pennsylvania.

Bill to Oust New Jersey Vehicle Tunnel Commission

A bill ousting the majority of the members of the New Jersey Interstate Bridge and Tunnel Commission, which is in joint charge, with a similar New York commission, of the Hudson River vehicle tunnel project, has made its appearance in the State Legislature at Trenton. During the term of the existing commission the work of tunnel construction, except for ventilating shafts on the New York side, has been repeatedly blocked, due to failure of the two commissions to agree on matters of administrative policy.

Private Garbage Collection for Salt Lake City

Salt Lake City recently entered into a contract with the Plymouth Stock Company by which the city is to pay the company $13,500 per year for the collection of residential garbage, heretofore collected by the city. The garbage is to be delivered at a receiving station to be established at the old union stock yards.

Iowa Society Raises Dues and Seeks More Members

To meet the need for money to carry out its program of expansion, including a half-time secretary, the Iowa Society of Engineers at its recent Sioux City meeting raised the annual dues from $6 to $10 for members; juniors' dues were raised from $4 to $6. The vote was unanimous. As a further source of revenue a sustaining membership costing $25 annually was provided. Already 25 to 30 members have signified their intention of becoming sustaining members.

The increase in dues of the 550 members, however, is not considered sufficient and a campaign is under way to enlist a large increase in numbers. There are 1,135 registered engineers in the state, according to a report of K. C. Kastberg, secretary of the Board of Engineering Examiners, and probably 400 to 500 unregistered engineers in subordinate positions.

The society is strongly in favor of registering engineers and a movement is on foot by the architects to join the engineers in passing a combined bill based on the model law of the Federated American Engineering Societies.

Since the annual meeting conflicted with the dates of several other important societies an amendment was introduced to make the time of meeting flexible.

One of the most important innovations introduced at the meeting was the plan of the local committee in arranging for talks by visiting engineers before the noon luncheon clubs of business men and also an assembly at Morningside College. The result sought was to effect personal contacts between engineers and business and professional men of Sioux City thereby creating a better understanding.

U. S. Chamber of Commerce Opposes Metric System

Adoption of the metric system as the sole standard of weights and measures in the United States was disapproved by the National Council of the Chamber of Commerce of the United States at its recent mid-year meeting. The council refused to follow the recommendation of a special committee that the subject be submitted to a referendum of the Chamber membership.

Recommend Competitive Bidding for Salt Lake Improvements

The General Association of Contractors of Utah presented a suggestion to the city commissioners of Salt Lake City recently, that they adopt a policy of awarding contracts for all public improvements on a competitive bidding basis, instead of doing part of the work in the regular city departments.

Special attention was called in the communication to two conduits now under construction with estimated costs of about $10,000 each. The association announced that it was ready to co-operate with the commission on all improvement work and recommended that contracts for such work be let after competitive bidding.

The contractors believe the cost under the present plan to be excessive.

Slate Producers Organize

Action was taken to form a national organization at a meeting of slate producers held at the Engineers' Club, New York, Feb. 8, under the auspices of the National Federation of Construction Industries. About 50 delegates, representing all the slate-producing sections in eastern states, except Virginia, were present. It was decided by unanimous vote to organize, and a committee of 7 was appointed to suggest a name, prepare a constitution and by-laws, and issue a call for a future meeting to complete organization.

In opening the meeting as chairman, Oliver Bowles, mineral technologist, U. S. Bureau of Mines, spoke of the prevalence of unscientific methods of quarrying slate and the need of substituting machinery for manual labor. Waste, he stated, was enormous—in some quarries over 90 per cent—and no considerable development of by-products has been undertaken. Slate production, and particularly the production of roofing slate, has rapidly decreased and substitute materials have gained precedence, very largely because no concerted effort was being made by the industry to maintain and strengthen the market for slate. G. F. Laughlin, U. S. Geological Survey, in endorsing the movement to organize, deplored the decreasing use of a material naturally so superior as slate for many purposes.

Standardization was urged by Victor D. Abel, Structural Service Bureau, Philadelphia. At present sanitary slate products have to be manufactured to order, thus preventing producers from manufacturing for stock. Studies recently made, he said, showed that most sanitary and chemical slate products could be standardized to a great degree without the slightest disadvantage in use. D. Knickerbacker Boyd, architect and structural standardist, also urged standardization as a means of increasing the market for slate.

Competition for Moving-Platform Project in Paris

The city of Paris, France, has announced a competition for moving-platform projects with the idea of relieving congestion of traffic along the grand boulevards and other thoroughfares. The platforms, according to present plans, are to be located underground. The competition closes Sept. 20, 1922, and contestants are advised to send their plans to "La Direction Générale des Travaux de Paris, 98 Quai de la Rappée, Paris, France." The competition is open to engineers and inventors of all countries and three prizes, amounting respectively to 100,000 francs, 50,000 francs, and 30,000 francs, are announced. The successful projects will remain the property of their promoters who have the right to make such use of them outside of the city of Paris and the Department of the Seine as they may wish.

Competitors are requested to submit a memorandum giving information regarding the mechanical details of their systems, dimensions of parts, kind of traction used, starting devices, etc., maximum grade and minimum radius of curvature allowable, data as to speed, estimate of first cost and cost of operation, longitudinal and cross-sectional plans, and similar information necessary to a complete understanding of the project submitted. A fee of 100 francs is demanded of entrants in the competition.

In case actual construction of a moving-platform project is undertaken on a large scale, the city of Paris reserves rights to the plans by paying the inventor an indemnity of 500,000 francs, unless some other agreement may be reached.

Full details regarding the competition are contained in the Bulletin Municipal Officiel, of Paris, dated Dec. 30, 1921, a copy of which has been made available for the use of *Engineering News-Record* through the courtesy of Robert Ridgway, chief engineer, New York Transit Commission.

Chicago Labor Unions Accept Landis Award

Chicago labor has agreed to go to work. Judge Landis on Feb. 1 fixed Chicago wage rates for a year beginning June 1, substantially the same as those now in effect. Three days later the Building Trades Council, representing the unions, agreed to accept the scales and other conditions with reference to restrictions. The unions also agreed to let the non-union men continue working until the employers are assured of the good faith of the unions. Only the carpenters dissented from the nearly unanimous agreement on the part of the unions to go to work. They insisted on a wage of $1.10 per hour while the Landis scale calls for $1.00 only. About 60 per cent of the carpenters now at work are said to be non-union.

The citizens' committee to enforce the Landis award joined the two contractors' associations in a newspaper advertisement in which the committee states its lack of confidence in the ten insurgent unions and pledges its continuous support to men now working open shop in these particular trades, although union men who desire to go to work will be given positions in the order of their applications. A month ago the conservative element in the Chicago Building Trades Council was overthrown and a new set of officers, pledged to nullify the Landis award, was selected. A general strike was immediately called but proved a failure. This is the basis, as published, for the lack of confidence expressed by the committee.

The temporary injunction sought by the carpenters to restrict the activities of the citizens' committee has been denied, mainly because the carpenters did not come into court with clean hands, the judge referring to assaults on non-union men by members of the union while the case was in the hands of the court.

Seattle Wants Bids on 17 Miles of 66-in. Steel or Wood Pipe

Plans and specifications for 17 miles of 66-in. conduit, comprising Cedar River Pipe Line No. 3, of the waterworks of Seattle, Wash., have been approved and alternative bids for steel and for creosoted wood pipe will be invited within about a month. The conduit will extend from a point near Swan Lake to the Volunteer Park Reservoir, in Seattle, and is estimated to cost $2,000,000. Swan Lake will eventually become an impounding reservoir, and for this purpose a $75,000 dam has been built across the outlet of the lake. When Pipe Line No. 3 is constructed, Lines Nos. 1 and 2, now leading from the Cedar River watershed, will be diverted into the lake and a tunnel will be built from the lower end of the lake to the point where No. 3 line begins. Through this tunnel, water will be brought from the lake and sent into all three pipe lines. The Swan Lake water supply project, when completed, will cost about $6,000,000.

Broad-Gage Railroad to Tap Montana Mining Region

According to a report from the firm of J. P. Ernster & A. W. Barker, engineers of Minneapolis, surveys have practically been completed for the location and construction of a broad-gage railroad from Columbus, on the main line of the Northern Pacific R.R. in Montana, southwesterly into the New World mining district. The country tapped by the railroad is rich in coal, timber, and minerals. The road will be 83 miles in length. Construction is to start early in the spring. Designs are now being prepared for a bridge which is to span the Yellowstone River. All of the engineering work is in the hands of the above-mentioned firm.

Research Graduate Assistantships Open at Illinois

The dean and director of the college of engineering and the engineering experiment station of the University of Illinois has announced that a number of research graduate assistantships are available for graduate students who wish to secure degrees of Master of Science through research work in civil engineering. If the full quota of research graduate assistantships is secured, there will be ten vacancies to fill and in addition one in gas engineering. Applications for appointment to these vacancies should be sent to Dean C. R. Richards, at Urbana-Champaign. They should reach him not later than March 1. Application blanks will be furnished upon request.

Hoover Presents Views on Railroad Needs

Outlines to Commerce Commission Effect of Carriers' Plight on General Business

In a statement before the Interstate Commerce Commission Feb. 3, Secretary of Commerce Hoover declared that the greatest impulse that can be given to business recovery from any source is a reduction of railroad rates on primary commodities, combined with the immediate resumption of railroad construction and equipment. He divided his program for progress in these directions into three periods: (1) The immediate present; (2) the early period of decreasing costs, increasing efficiency and slowly recovering traffics; and (3) the period of normal operations.

Although the present lean earnings of the railroads preclude the possibility of immediate important rate relief, Secretary Hoover believes that there are cases in which lower rates would recover lost traffic and increase earnings. In order to stimulate improvements he advocates the use of government credit through the medium of a guarantee on equipment trusts.

Prospects for 1922

During 1922, designated as the second period, the Secretary assumes that railroad wages and supplies will at least in part fall to the levels of decreased cost of living, that efficiency of operation will increase and that the volume of traffic will increase toward normal. These savings, he believes, should be devoted to the reduction of rates on primary commodities.

On the return of normal business conditions, Secretary Hoover believes, the rates on primary commodities can eventually be reduced to a pre-war basis and still earn sufficient to insure the free flow of capital into new construction.

In discussing the influence of the railroads on general business conditions, Secretary Hoover said:

"One thing is absolute. Our transportation facilities are below the needs of our country, and unless we have a quick resumption of construction, the whole community—agricultural, commercial, and industrial—will be gasping from a strangulation caused by insufficient transportation the moment that our business activities resume. For the past five years, we have had no consequential expansion to our railway transportation machine. With but one interval of 9 months in 1918 and 1919 we had a car shortage throughout the whole of the years 1916-17-18-19 and 20. This shortage rose to as high as 160,000 cars with a corresponding shortage of motive power. We paid tremendous sums in commercial losses and unemployment in consequence. We laid it onto the war. We should lay it onto our lack of foresight and antagonism to railroads.

Expansion Necessary

"Few people seem to realize the amount of expansion in our transportation machinery necessary to keep pace with the growth of the country. And an equal few seem to have any notion of the price we pay for not having it Our country is more dependent upon railway transport than any other. All others have comparatively greater coast

lines and internal waterways. The experience of the twenty years before the war has shown that we must build an extension of lines, including terminal facilities, additional sidings, etc., every year equal to the construction of a new railway from New York to San Francisco. We must add at least 120,000 cars and 2,500 locomotives annually to our equipment.

"Since we entered the war in 1917 we have constructed at least 10,000 miles of railways less than our increasing population and economic development called for and we are behind in rolling stock by about 4,000 locomotives and 200,000 cars. I wish to emphasize that unless we can have an immediate resumption of construction and equipment, our commercial community will pay treble the cost of the whole of them in their losses of a single season. The very moment that we reach anything like normal business we shall see a repetition of car shortages, followed by an increase in the cost of coal to the consumer from $1 to $3 a ton; we shall again see premiums of 20c. a bushel for the use of cars for moving grain; we shall in fact see a shortage of commodities to the consumer; and we shall see gluts upon the hands of the producers. We shall see factories, filled with orders, again closed for lack of cars; we shall see large intermittency in employment; and we shall see the usual profiteering in commodities due to a stricture between the producer and the consumer.

"There would be no difficulty whatever, by basing such losses on the experiences we have already had, to calculate a loss to the American people of a billion dollars for each one of these periodic transportation shortages.

SPENDING A BILLION TO ADVANTAGE

"We talk glibly of giving billions of credits to foreign countries, to increase our farm exports. I wish to say with all responsibility for the statement that a billion dollars spent upon American railways will give more employment to our people, more advance to our industry, more assistance to our farmers, than twice that sum expended outside the frontiers of the United States—and there will be greater security for the investor."

Secretary Hoover deprecated criticism of our railroad system on the ground of inefficiency and expressed his conviction that, in comparison with foreign railways, our own are of higher standards, better in methods, and growing in efficiency. He said in speaking of Government ownership, "No one with a week's observation of government railways abroad, or with government operation of industry in the United States, will contend that our railways could ever be operated as intelligently or as efficiently by the Government as through the initiative of private individuals. Moreover, the welfare of its multitudes of workers will be far worse under Government operation."

Aqueduct Commissioner Dies

Francis M. Scott, member of the Aqueduct Commission of New York City from 1888 until he became corporation counsel in 1895, died on Feb. 5. At the time of his death he was chairman of the recently appointed Charter Revision Committee of New York City.

Investigate Identical Cement Bids in Indiana

Governor McCray and the state legal and highway departments of Indiana are undecided as to what they can do about identical cement bids submitted to the state highway commission recently by three cement companies. They were in conference with representatives of cement interests Feb. 8.

The Governor said the cement representatives explained in the conference that the Universal Portland Cement Co. is the big cement manufacturer, and that when it quotes prices "all the other smaller companies come in under the wire." This, he said, was the explanation of the companies for the fact that three bids submitted for the highway department business were identical. Blaine S. Smith, of Chicago, representative of the Universal company, and spokesman for the cement men, would make no statement concerning the conference.

Besides Mr. Smith there were in the conference B. H. Rader, of the Lehigh Portland Cement Co., of Chicago; Harry Jennings, Wabash Portland Cement Co., Detroit; D. H. McFarland, Atlas Portland Cement Co., Chicago; O. A. Strass, Indiana Portland Cement Co., Greencastle, and others.

The state is in the market for approximately $500,000 worth of cement to be used principally in highway improvement. U. S. Lesh, attorney-general, is investigating to see whether the state can break up what the state officials believe is a cement trust.

Metcalf Comments on Boston's Society Affiliation Move

The idea of bringing into closer cooperation or affiliation the technical societies of Boston and vicinity for more effective public service, and economy of time and expense, as announced in this journal Feb. 9, p. 257, has been current in Boston for at least 30 years. At *Engineering News-Record's* request Leonard Metcalf has made the following comment on the movement:

It took definite form in 1911 when the Engineers Club of Boston was incorporated and its incorporators hoped that the club might become a center of activity in matters touching the public interest in which engineers might be particularly interested or capable of service. This hope was, however, not realized in any large measure.

Two years or more ago, representatives of sixteen or more technical societies or sections of national societies held conference with the same end in view, and a committee was appointed to investigate such a project and report its findings. This effort too failed. The interest and faith, however, of a small group of far-sighted men who were members of various technical societies in Boston, persisted, and resulted in the development of the specific plan covered by the "Prospectus on the Affiliation of Technical Societies," which is now under active consideration.

The details of the working agreement between the several societies have not yet been perfected, but the general project to affiliate has been unanimously endorsed by the local sections of the Americal Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Heating and Ventilating Engineers, the American Association of Engineers and by the Plant Engineers' Club. It has been favorably reported by the board of government of the Boston Society of Civil Engineers and will be acted upon at the next meeting of the society. It has been disapproved by the American Chemical Society. The American Institute of Mining and Metallurgical Engineers and the New England Water Works Association have not yet acted upon the matter. The Northeastern Section of the American Society of Civil Engineers has already affiliated with the Boston Society of Civil Engineers and has voted to participate in the movement which has been inaugurated.

It may fairly be said, therefore, that the engineers of the Boston district heartily favor the principle of affiliation and there is every reason to believe that a workable plan will soon be evolved for bringing about the desired result.

$60,000,000 Available for Highway Work in Texas

Records of the State Highway Department show that over $25,000,000 were spent on the designated highways of Texas during the calendar year 1921—more than twice as much as had been spent during the four years prior to 1921. This amount was spent on state roads under the direct supervision of the highway department and does not include the amount spent by individual counties, which is estimated at between $25,000,000 and $30,000,000 additional, making an approximate total of $50,000,000 spent on the highways of Texas during 1921.

Up to Jan. 1, 1922, there was an unexpended balance of $13,391,859.35 state and federal aid and the department's share of the Registration fees for 1922 is estimated at $1,750,000 over and above operating expenses, which means that there will be more than $15,000,000 aid available for 1922 and future road construction. The total amount has already been allotted and at least $7,000,000 is under contract at the present time. The allotments were made early in order that the various counties might get their work under way as soon as possible and at the same time help relieve the unemployment situation in Texas. The $15,000,000 state and federal aid represents about 35 per cent of the total amount that will be expended, making approximately $60,000,000 available for future road work under the present road building program.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

PERSONAL NOTES

A. N. REECE has been appointed chief engineer of the Kansas City Southern Railway Co. with headquarters at Kansas City. Mr. Reece, who is a graduate of the University of Kansas, was formerly connected with the St. Louis and San Francisco R.R.

J. W. MARTIN, structural engineer with the Whitehead & Kales Co., Detroit, Mich., has been appointed chief engineer for the York Milk Machinery Co. at York, Pa.

H. O. WILES, formerly city engineer of Bluefield, W. Va., has been appointed county engineer of Wayne County, W. Va., succeeding H. A. Levering, resigned.

ROBERT M. GATES has resigned his position as engineer with the Lakewood Engineering Co., effective Feb. 1.

GEORGE K. ALLEN, Red Bank, N. J., has been appointed county engineer, Monmouth County, N. J., succeeding George B. Cooper.

STEPHEN S. BUNKER, for the past nine years an engineer of the state highway commission in Maine, has been appointed city engineer of Bangor, Me. Mr. Bunker is a graduate of the University of Maine, class of 1897. Under the amendment to the city charter the city engineer will be in charge of the street and highway, park and sewer departments, with power to appoint subordinates approved by the board of public works.

JOHN K. GRONHOLT, who has had charge of Highway construction on the National Trail, a federal aid road in Bond County, Ill., has been promoted from junior to Assistant State Highway Engineer and put in charge of highway construction in Jersey, Calhoun, Macoupin and Green Counties with headquarters at Carrollton, Ill.

ROBERT H. WHITTEN, of Cleveland, has been appointed consulting engineer for the city plan commission of Indianapolis, Ind., at a salary of $4,800 per year.

H. E. FEELEMYER has taken over the business of the Ajax Engineering Corp. of Philadelphia.

L. J. TOWNE, who has been in the engineering department of Stone & Webster, Boston, for four years, has been appointed structural engineer.

EARL WHEELER, formerly local manager of the Washington, D. C. office of the General Electric Co., has become associated with the investment department of Dominick & Dominick, members of the New York Stock Exchange. He will specialize in engineering, industrial, and public utility securities.

LEWIS E. MOORE, formerly associate professor of structural engineering at the Massachusetts Institute of Technology, and recently with the Massachusetts Department of Public Utilities, is now in consulting engineering practice in Boston. Mr. Moore specializes in designs and specifications for the strengthening of old bridges, buildings and foundations.

O. A. MECHLIN, formerly consulting engineer, Washington, D. C. has become associated with W. G. Triest in the Triest Contracting Corp., New York City, which was formerly known as the Associated Contractors, Inc. During the war, Mr. Mechlin was commander in the Civil Engineer Corps of the U. S. Navy, in the charge of the construction of the large concrete army and navy office building in Washington, D. C. Later he was attached to the League Island Navy Yard.

COL. JOHN R. FORDYCE, who served in the Construction Division of the Army during the war, has been appointed by Governor McRae State Highway Commissioner of Arkansas. He is the first engineer to hold this position.

STUART MANNELL, manager of the A. G. de Sherbinin & Co., importers, exporters and engineers, has been elected president of the Engineers' Club of Seattle.

CAPT. A. W. FUCHS, formerly of the U. S. Public Health Service, has resigned to become sanitary engineer for the Missouri Pacific R.R., with headquarters at Memphis, Tenn.

B. C. MCCURDY, formerly with the highway department of the Morgan Engineering Co., has been made county highway engineer of St. Clair County, Ill.

A. G. BARTLETT, who has been a member of the City Planning Commission, Los Angeles, Cal., has resigned to become a member of the board of public service commissioners.

BRADLEY STOUGHTON, formerly secretary of the American Institute of Mining and Metallurgical Engineers, has been elected president of the Yale Engineering Association.

F. UHLENHAUT, JR., for twenty-two years chief engineer of the Philadelphia Co., of Pittsburgh, Pa., has retired. He has been succeeded by Capt. Ralph Rainsford of New York.

CLARENCE W. HUBBELL has resigned as city engineer of Detroit, Mich., to resume his private practice, his resignation to become effective March 1. Mr. Hubbell has been city engineer of Detroit since January, 1917. He accepted the position after having been formerly engaged by the Detroit Water Board on a survey to determine the degree of pollution of the Detroit River, and took a particular interest in the sewer program started at the time of his appointment as city engineer. During the time he has held his present position the sewer program costing approximately $40,000,000 and providing drainage for over 40 square miles of newly annexed territory has been practically completed. Mr. Hubbell will maintain an office in Detroit as consulting engineer.

OBITUARY

DENNIS O'BRIEN, president of the general contracting firm of Dennis O'Brien & Sons Co., Inc., Hartford and Middletown, Conn., died at his home in Middletown Feb. 4. Mr. O'Brien was 72 years old, and has been associated with the building business in Connecticut for the past 45 years. During that time he has constructed several large building and factories in Hartford, among them being the extensive Royal Typewriter plant there.

FRANK CHITTENDEN OSBORN, of the Osborn Engineering Co., Inc., Cleveland, Ohio, died suddenly on Jan. 31. A fuller notice of Mr. Osborn's life and work will appear in next week's issue.

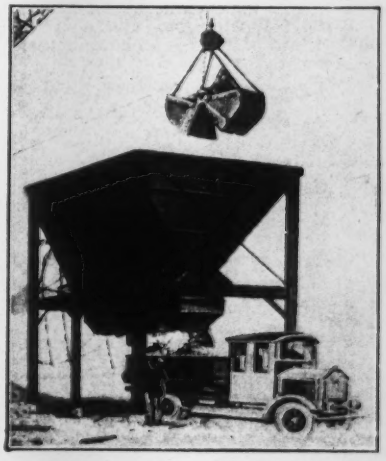
J. J. WRIGHT, for many years manager of the Toronto Electric Light Co., and builder of one of the first electric railways in Canada, died at Newcastle, Ont., Jan. 31.

DUDLEY BALDWIN HINE, superintendent of bridges and buildings for the Guayaquil & Quito R.R., died in Ecuador Jan. 18 from injuries sustained while at work. His home was in Los Angeles, Cal.

EQUIPMENT AND MATERIALS

Steel Materials Bins Equipped With Measuring Hoppers

Steel bins for aggregate road work provided with measuring hoppers adjustable to size of batch are being manufactured by the Blaw-Knox Co., Pittsburgh, Pa. The bins are assembled and dismantled in sections which can be transported by truck. The measuring hopper called a "batcher" is made entirely of steel and is located immediately beneath the bin; it includes the bin gate for the bottom of the storage bin. Operation, it is stated, necessitates no greater effort than is required by closing and opening any gate attached to a storage bin. When the storage bin gate is closed, the material is struck off. The right volume is then held suspended. When the hoppers are



full and the storage bin gate is closed, one operator can dump one, two, three, or four at the same time, thus loading a four-compartment truck with sand and stone in less than ten seconds. Only one workman is necessary to operate a 100-ton capacity bin having four measuring hoppers of sand and four measuring hoppers of stone. Each hopper consists of two parts, a top cone and a lower section. The top cone moves within the lower section, and an adjustment of a fraction of a cubic foot can be obtained at will. By the use of lock bolts which are furnished as part of the outfit or by other simple methods, the engineer or contractor can seal the adjusting mechanism so that no change can be made without his knowledge.

Business Side of Construction

Facts and Events that Affect Cost and Volume

The Low Exchange Rates

Par and Current Rates for European Money and What They Mean—The Mighty Dollar

Each week in the Trend of Business column brief consideration is usually given to current rates of foreign exchange. The value of foreign moneys in terms of United States currency has an important bearing on commerce and a certain influence on the money market of this country. It is therefore important for even the casual student of business to understand what is implied by the current rates of exchange.

The soundness or value of a currency depends largely upon the amount of paper money in circulation. For example, par value of the German mark is 23.8 cents. One authority states that in 1914 Germany had 2,000,000,000 marks outstanding, against about 95,000,000,000 now. The present quotation is 0.505 cents (Feb. 15), while in November 0.33 cents was quoted.

The situation is more or less the same as regards other European currencies. The Russian ruble was once worth 51 cents; its present value is negligible outside Russia. The Polish mark at par is worth 23.8 cents; it is now quoted at 0.03125 cents — one seventy-sixth its par value.

The seriousness of the exchange situation—also of the European economic situation—will be evident by examination of the following par and current demand values of European currencies:

	Par in Cents	Denomination	Current Value in Cents
England	486 62½	sovereign	435.50
France	19.3	franc	8.63½
Italy	19.3	lira	4.87
Belgium	19.3	franc	8.23½
Germany	23.8	mark	0.50½
Austria	20.3	crown	0.03½
Poland	23.8	mark	0.03½
Greece	19.3	drachma	4.58
Rumania	19.3	leu	0.80
Serbia	19.3	franc	1.32
Spain	19.3	peseta	15.73
Holland	40.2	florin	37.35
Sweden	26.8	crown	26.05
Norway	26.8	crown	16.60
Denmark	26.8	crown	20.55

A large American importer asserts that the dollar is the form of payment in overwhelming demand by European exporters to this country. Europe does not want to be paid in its own currency. Exporting to Europe is light. Construction machinery is sold abroad even now, but materials are not being exported. As regards foreign products, American concerns prefer to buy from importers than to place orders directly with foreign houses. Such purchases are usually spot from stock.

Although the American dollar is worth only about 60 cents in its own country (as compared with its buying power in prewar days), it is the purchasing unit of the world. The persistant acuteness of the exchange situation has given rise to much talk of an international bank and currency, and the idea seems to be gaining favor.

Next Week — Comparison of cement prices with some other construction materials. With graphs.

The Decision in the "Open Competition" Case

The National Lumber Manufacturers Association has taken the position that it will not advise or recommend to any of the subscribing associations any specific policy with respect to any of their activities. It urges, however, that each association give careful consideration to the applicability, if any, of the recent decision of the Supreme Court in the American Hardwood case of their own activities and that they do so in the light of competent legal advice and of full knowledge of the policies of the Government, as and when they may be announced. Such was the advice given recently by the Secretary and Manager, Wilson Compton, to the annual conventions of the Michigan Hardwood Manufacturers Association and the Northern Hemlock and Hardwood Manufacturers Association.

In the meantime, Mr. Compton stated, scrupulous associations need not fear unreasonable or oppressive action, for both Secretary of Commerce Hoover and Attorney General Daugherty are broad-minded, intelligent and observant men who are not likely to "whack" associations that exhibit a real purpose and desire to abide by the law. But there is no place for a spirit of evasion of law.

The apparent aim of the Government is free competition, conducted intelligently. Mr. Compton stated that in his judgment as a result of his inquiry and observation, general action against trade associations as a whole is not likely. Rather that an effort will be made, as it ought to be made, "to separate the goats from the sheep." The Government undoubtedly realizes that the trade association marks a stage in economic progress — else it would not have developed as it has among American industries; and that unreasonable interference with helpful trade co-operation would only mean its dispersion and the consequent setting back of the clock of the country's business progress twenty or thirty years.

Representative Public Bond Sales in January

Long term municipal bond sales in the United States, for the month of January, 1922, reached a total over $94,000,000 as compared with a total of slightly over $86,000,000 for January, 1921. Among the important bond issues of the month were: State of Oregon, $1,000,000 5s; Chicago Sanitary District, Chicago, Ill., $5,000,000 5s; Merced Irrigation District, Cal., $3,120,000 6s, and Minneapolis, Minn., $2,295,000 4½s. Following are some representative sales:

REPRESENTATIVE BOND SALES OF JANUARY, 1922

State	Purpose	Amount	Maturity	Rate per Cent	Sold for	Dated
Idaho	Highways	$250,000	1923	5.1	100.06	Jan. 16, 1922
County						
Allen Parish						
Rd. Dist. No. 3, La.	Roads	136,000	Due serially 1 to 13 yr.	5	85.50	Dec. 1, 1919
Door, Wis.	Highway	75,000		5	100	
Montgomery, N. Y.	Highway	70,096	$14,096—1926 $14,000—1927—30	5½	100.823	Feb. 1, 1922
Morgan, Ohio	Bridge repair	23,500	1922—32	6	102.06	Jan. 1, 1922
Noble, Ind.	Highway	39,480	1923—32	5	100	Jan. 15, 1922
Palo Pinto, Tex.	Roads	250,000		5½	94.70	
Westmoreland, Pa.	Roads	375,000 375,000	1931 $37,000—1932—40 $42,000—1941	5 5½	101.563	Sept. 1, 1921
Wright, Iowa	Road Bridge	65,000 30,000	1929	5½	102.87	
Brooks, Ga.	Road	280,000		5	100.	Jan. 1, 1920
Central Highway						
Dist. Lewis Co., Ida	Highway	50,000		6	100	Jan. 14, 1922
Chippewa, Mich.	Road	75,000	1923—28	5½	100.34	Feb. 1, 1922
Douglas, Neb.	Road-paving	1,000,000	1937—41	5	103.20	Oct. 1, 1919
Greene Township						
Erie Co., Pa.	Roads	11,000	1926—27	6	100.	Dec. 8, 1920
Municipality						
Akron, Ohio	Tunk sewer	500,000	$16,000 yearly 1923—32 $17,000 yearly 1933—52	5½	105.183	Feb. 1, 1922
Ardmore, S. D.	Water-works	29,500	1940	5	100.	Feb. 15, 1922
Arkport, N. Y.	Ltg. System	15,000	1925—34	5	100.39	Feb. 15, 1922
Collegeview, Neb.	Paving	95,000	1940	6	96.50	Jan. 1, 1920
Fort Lee, N. J.	Temporary Imp.	250,000	1928	5½	100.	Feb. 1, 1922
Fulton, N. Y.	Bridge	4,000	1923—26	5	100.30	Feb. 1, 1922
Glovesville, N. Y.	Waterworks	173,500	1922—32	5½	101.58	Apr. 1, 1920
Livingston, Tenn.	Street Imprvt.	25,000	1922—32 1922—42	6	100.	
Mt. Vernon, N. Y.	Incinerator	65,000	$3,000—1923—41 $8,000—1942	4½	100.89	Feb. 1, 1922
New Haven, Conn.	Park Imprvt.	250,000	1947	4½	107.172	Jan. 1, 1922
Plattsburgh, N. Y.	Waterworks	100,000	1923—32	5	103.78	Jan. 1, 1922
Seaford, Del.	St. Improvement	25,000	1951	5	100.	Sept. 15, 1921
Yakima, Wash.	Sewer	80,000	1942	6	105.38	Dec. 1, 1921
Berlin, N. H.	High-school bldg.	400,000	1922—41	5	102.20	Nov. 1, 1921
Burlingame, Cal.	City Imprvt.	60,000	1923—52	5½	106.15	Jan. 16, 1922
Elm City, N. C.	Electric light	25,000	1942	6	100.	Feb. 1, 1922
East Orange, N. J.	Gen. Imprvt.	476,000	$17,000—1922—25 $18,000—1926—47 $12,000—1948	5	105.07	Dec. 1, 1921

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 63@69 are the following large projects: A 9-story office building in Chicago, Ill., to Leonard Construction Co., 37 South Wabash Ave., $2,000,000; an 8-story hospital in New York City, to M. Eidlitz & Son, Inc., 41 East 42nd St., New York, $1,000,000.

Policy of National Lumber Manufacturers Assn.

As Recently Outlined by the Secretary and Manager of the Organization.

"The National Lumber Manufacturers Association can, in my judgment, be conducted in only one of two ways, namely, either for the sake of avoiding criticism, or for the sake of doing the greatest benefit to the lumbermen composing the regional associations. It is not possible to conduct effectively an enterprise of this sort without encountering criticism. For the most part the criticism of the National Association has been with a desire for enlightenment and has had a constructive purpose. But as long as lumbermen, even in their own regional groups, are not in agreement on some of the practical problems which confront the industry, one of two things must occur, so far as they relate to the affairs of the National Association, either nothing must be done, and as a consequence important interests of the industry go by default; or, criticism and occasional controversy must be expected.

"It is perfectly practicable for an organization of this sort to be conducted with great effectiveness, openly and frankly in the equal interest of all the subscribing associations. This, however, cannot be done without occasional refusal to meet the views and requests of individuals. But if ever the Association departs from the policy of impartiality, and of strict adherence to the activities in which all members are interested in common, it will have surrendered its only real title to the support and confidence of the lumbermen of the United States. I believe that the lumbermen should support a national organization of this kind only if they are willing to have it conducted in that way and for that purpose.

"The National Association has now a peculiar opportunity for helpfulness in that its activities are separate and apart from these activities which have recently become involved in legal controversy. In the interest of maintaining co-operation in the lumber industry there is, it seems to me, in the light of this situation, added reason for the maintenance of a strong national organization. This would apply no more and no less to the lumber industry than to other industries similarly situated."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 63@69 are the following:

A high school at Hartford, Conn., $1,500,000.

A clubhouse at Cincinnati, O., $2,000,000.

A hotel at Grand Rapids, Mich., $1,000,000.

An exposition building at Chicago, $5,000,000.

A water-works project for Seattle, Wash., $2,000,000.

A sewerage system for Los Angeles, Cal., $2,500,000.

Roadwork in Ontario, $4,000,000.

Paving 21 miles Cannon Ball Trail, Kansas, $575,000.

Plans for Unemployment Relief

Provision of actual funds by subscription and otherwise for the relief of unemployment conditions in various parts of the country are being undertaken according to a recent report made known by the Department of Commerce. New Haven, Conn., is raising a community chest of $500,000 which includes an item of $50,000 for an emergency fund for the unemployed. Hartford is advancing to unemployed persons on their notes in favor of the city small sums for repayment.

Detroit has appropriated $2,000,000 to meet unemployment conditions. Indianapolis has a city fund of about $165,000, and in addition $120,000 has been raised by popular subscription. This is to be used in municipal work and an increasing payroll is reported daily.

The sum of $3,500,000 has been raised in Cleveland and in Cincinnati the city council has appropriated $10,000 to the mayor's unemployment committee. One of the salutary features of the work being done to relieve unemployment is that reported from Poughkeepsie, N. Y. The city is lending up to $100 to any unemployed man of reputable character, and accepts his note for ninety days at reasonable interest, charged to make up for any loss which may occur through failure of others to pay.

Union Wages in Massachusetts 1914 to Date

More Uniform Rate Resulting from War Advance — Present Average 65 per cent over 1914 Schedule

Wages in the Massachusetts building trades rose from an average of 50.4 cents in July, 1914, to 97.2 in 1920, and then declined to 92.3 in 1921, giving an increase of 83.2 per cent for 1921, according to the Massachusetts Department of Labor and Industries. These averages are for thirteen crafts. *Engineering News-Record* quotes weekly the rates paid members of six skilled crafts—bricklayers, carpenters, hoisting engineers, hodcarriers, piledrivers and structural ironworkers,—and the average for Feb. 1, 1922, was 82.5. This would indicate that wages in Massachusetts are at present between 60 and 70 per cent above the 1914 schedule. The table gives the average union hourly rates as compiled by the Massachusetts Department of Labor and Industries. Present rates, as quoted by *Engineering News-Record*, are: Carpenters, 75c.; bricklayers, hoisting engineers and structural ironworkers, and piledrivers, 90c.; hodcarriers, 60c.

A comparison of the average rates for the several occupations in 1921 shows that the average rates for stonemasons, 98.9c.; plasterers, 98.3c.; bricklayers, 98c.; and lathers (wood, wire, and metal), 96.8c. were the four highest of the rates for the 13 occupations, but, when a comparison of the rates in 1921 is made with the corresponding rates in 1914, it is seen that the occupations in which highest percentage of increase were maintained were the paperhangers, 113,3 per cent; painters, 106.0 per cent; inside wiremen, 98.1 per cent; and decorators, 95.6 per cent, for each of which occupations the rates in 1914 were relatively low. Thus it will be noted that while the changes in the rates for the several occupations during the period 1914 to 1921 varied quite widely, yet the result was the establishment of a general standard.

AVERAGE UNION HOURLY RATES OF WAGES IN THE BUILDING TRADES IN MASSACHUSETTS, 1914, 1919, 1920 AND 1921.

Occupations	Number of Reports	Number of Municipalities	Average Hourly Rates of Wages, July 1 — 1914	1919	1920	1921	Per Cent Increase in Rates 1914 to 1919	1920	1921
All occupations represented.	230	69	$0.504	$0.737	$0.972	$0.923	46.3	92.9	83.2
Bricklayers	27	27	0.619	0.803	1.033	0.98	29.7	67.0	58.3
Carpenters (house)	61	60	0.467	0.719	0.959	0.899	54.0	105.3	87.6
Decorators	6	6	0.452	0.742	0.933	0.883	64.2	106.6	95.6
Hod carriers and laborers	6	5	0.392	0.579	0.75	0.717	47.9	91.4	83.0
Lathers (wood, wire and metal)	11	8	0.55	0.755	1.007	0.968	37.4	83.1	76.0
Painters	27	27	0.429	0.67	0.895	0.883	56.3	108.8	106.0
Paperhangers	6	6	0.426	0.65	0.933	0.908	52.6	119.2	113.3
Plasterers	15	15	0.598	0.797	1.052	0.983	33.3	76.0	64.6
Plumbers	21	21	0.525	0.747	0.979	0.945	42.2	86.4	80.0
Sheet metal workers	9	9	0.482	0.73	0.964	0.903	49.4	100.0	87.3
Steam fitters	19	19	0.502	0.748	0.987	0.942	49.0	96.4	87.5
Stonemasons	11	11	0.594	0.816	1.061	0.989	37.3	78.6	66.3
Wiremen (inside)	11	11	0.456	0.764	0.973	0.902	67.6	113.5	98.

Comptroller General's Decision Affects Building Contractors

Where specifications for construction of a building expressly require the contractor to clear the site for reception of the building and direct inspection of the site prior to submission of bids, the Government is not liable for cost of removing rock from the site not shown on the blue print, the object of the blue print being to show only the elevation and depression of the ground and not the presence of rock or other matter on the surface.

Delay in the approval of a contract can impose no liability upon the Government to reimburse the contractor for increased cost of labor and materials occurring between date of tentative contract and date of its final approval.

Under a contract providing for changes in the work during its progress when ordered in writing, and providing a corresponding increase or deduction in the price, the contractor can not be reimbursed for additional work on account of changes which were not ordered in writing.

Trend of Business

Bonds — Municipal issues light Liberty bonds strong and active. Railroad list active. An important successful offering was $30,000,000 Great Northern Ry. general mortgage 5½s at 96¾; yield 5.75.

Foreign exchange still rising.

Money plentiful; time loans 4½ per cent.

Primer for Lumber Buyers and Shippers

The National Lumber Bulletin prints nine definitions of general interest.

A *standard* equals 165 cubic feet or 1,980 board feet of lumber; about 1,650 board feet of squared timber; 1,320 board feet of logs.

A *cubic meter* equals 424 board feet of lumber; 353 board feet of hewn timber; 283 board feet of logs. Board measure is often expressed as "b.m."

A *metric ton* equals 1,000 kilos or 2,204.6 pounds. It is equivalent to 735 board feet of softwood lumber; 551 board feet of hardwood lumber; 490 board feet of logs (softwoods); 367 board feet of logs (hardwoods); 612 board feet of squared timber (softwoods); 459 board feet of squared timber (hardwoods).

A *hectare* equals 2,471 acres. F. O. B. means "free on board"; that is with freight not prepaid from point named. F. O. W. means "first open water," applied particularly to deliveries on cargoes in northern countries. C. I. F. means "cost, insurance and freight"; all three items being included in the quotation, to point named. F. A. S. means "free alongside ship." L. C. L. means "less than carload lot."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 2; the next, on March 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.50	$4.00	$2.63	$2.91	$3.50	$3.10	$3.36	$4.00
Structural rivets, 100 lb	3.50	5.00	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.20	3.50	2.53	2.81	3.42½	2.75	3.26	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9–5%	44%	53.7%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	48.30	40.60@42.60	46.00	52.00	50.00	+45.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.55	2.40	1.97	2.24	2.90	2.73	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	2.00	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	37.00	34.00	44.00	38.00	50.00	32.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	19.00	25.00	18.00	29.00	24.00	22.00	27.00	26.00
Lime common, lump, per bbl	2.75@3.48	1.50	2.75	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	+21.40	8.50	11.00	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	....	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.83	+.86	.93	+.88	+.93	+.98	.89	.86	.82
Common Labor:									
Common labor, union, hour	.60	.35	.....	72½	.40@.50	.50@.55	.62½	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.40	.35@.40	.40@.50	.35@.40	.43¾@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 95.8 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Structural steel shapes and plates are quoted at $1.40, Pittsburgh, for large tonnages and $1.50 for smaller lots; reinforcing bars are quoted at $1.40@$1.50 per 100 lb. Mill shipments, New York, of shapes and bars are quoted at $1.78@$1.88 per 100 lb. Mill price reductions on wire nails, rails and six other leading steel products have been quoted during the week; bringing the average price of the eight products very close to the 1913 level.

Cast-iron pipe is quoted at $45 as against $44 per ton in Seattle, prices unchanged in eight other cities reporting.

Cement, quoted last week in New York at $2.20@$2.30 per bbl. (net) has shown a tendency this week to maintain the $2.30 level.

Continued depletion of the winter reserve of common brick in New York city and ice-bound waterways necessitating rail shipments of fresh supplies, have combined to advance the price $1 per 1,000 wholesale. Brick are now quoted at $18 as against $17 one week ago.

Linseed oil has advanced 4c. in New York and Chicago, 1c. in Atlanta, 2c. in Minneapolis and 3c. per gal. (5 bbl. lots) in Denver.

One hundred and twenty-nine mills reporting to the West Coast Lumbermens' Association for the week ending February 4, show 75,959,140 ft. cut; 66,361,854 ft. sold and 63,368,338 ft. shipped. Production was 13 per cent below normal, shipments 17 per cent cent and new business 13 per cent below production. One hundred and thirty-two mills reporting to the Southern Pine Association for the week ending February 3 show 74,798,573 ft. cut; 61,225,780 ft. shipped and orders for 62,068,820 ft. Production was 19 per cent; orders 33 per cent and shipments 34 per cent below normal.